Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

Curriculum under Credit Based Grading System

M.Sc. Botany

Semester-I & II

Run at college level from the

Academic Year 2015-2016

M. Sc. Botany
Course Structure

Sr. No.	Course No.	Title of the Course	Hrs	Credits Allotted	Theory				Practical	
					internal	External	(Maximum)	Minimum	Maximum	Minimum
Semester I										
01.	BOT 401	Cell Biology	08	4T + 2 P	20	80	100	40	50	20
02.	BOT 402	Molecular Biologogy	08	4T + 2 P	20	80	100	40	50	20
03.	BOT 403	Biology and diversity of Virus, Phytoplasma, Bacteria, algae and fungi	08	4T + 2 P	20	80	100	40	50	20
04.	BOT 404	Taxonomy of Angiosperms	08	4T + 2 P	20	80	100	40	50	20
05		Seminars and Tutorial	03	3T	--	--	--	--	--	--
		Total		**27 Credits**						
Semester II										
06.	BOT 405	Cytology and Genetics	08	4 T + 2 P	20	80	100	40	50	20
07.	BOT 406	Plant development and reproduction	08	4T + 2 P	20	80	100	40	50	20
08.	BOT 407	Biotechnology	08	4T + 2 P	20	80	100	40	50	20
09.	BOT 408	Plant Physiology and Metabolism	08	4T + 2 P	20	80	100	40	50	20
10		Seminars and Tutorial	03	3T	--	--	--	--	--	--
		Total		**27 Credits**						
Semester III										
11.	BOT 501	Biology and Diversity of Bryophytes, Pteridophytes and Gymnosperms	08	4T + 2 P	20	80	100	40	50	20
12.	BOT 502	Ecology and Conservation	08	4T + 2 P	20	80	100	40	50	20
1.	BOT 521 A BOT 521 B BOT 521 C BOT 521 D	Crop Genetics and Plant Breeding - I Plant Pathology-I Taxonomy of Angiosperms - I Advanced Plant Physiology and Biochem. - I	07	3T + 2 P	20	80	100	40	50	20
15.	BOT 522 A BOT 522 B BOT 522 C BOT 522 D	Crop Genetics and Plant Breeding - II Plant Pathology-II Taxonomy of Angiosperms - II Advanced Plant Physiology and Biochem. II	07	3T + 2 P Each	20	80	100	40	50	20
		Project Work	03	3T	--	--	--	--	--	--
16	Service Course	Plant Tissue Culture	04	4T	--	--	100	40	--	--
		Total		**29 Credits**						

Semester IV										
17.	BOT 504	Bioprospecting and Plant Resource Utilization	08	4T +2 P	20	80	100	40	50	20
18.	BOT 505	Genetic Engineering and Bioinformatics	08	4T + 2P	20	80	100	40	50	20
20.	BOT 523 A BOT 523 B BOT 523 C BOT 523 D	Advanced Genetics & Molecular Biology – I Plant Pathology – III Taxonomy of Angiosperms – III Plant Physiology – III	07	3T + 2P	20	80	100	40	50	20
21.	BOT 524 A BOT 524 B BOT 524 C BOT 524 D	Advanced Genetics & Molecular Biology – II Plant Pathology – IV Taxonomy of Angiosperms – IV Advanced Plant Physiology -IV	07	3T + 2 P Each	20	80	100	40	--	--
		Project Work	07	7T	--	--	--	--	50	20
		Total		**29 Credits**						

Total Credits requiredobtaining M. Sc. Degree in Botany

Semester I 27

Semester II 27

Semester III 29

Semester IV 29

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Total credits112

*** At least one service course**

BOT 401

Cell Biology

Unit I .i.**Prokaryotic and eukaryotic Cell:** The ultra-structural details and comparative assessment.

Unit II i. Plasma membrane: Molecular .organization, current models and functions. Cell wallarchitecture, biosynthesis, assembly, growth and cell expansion.

iiPlasmodesmata: Structure and role in movement of molecules andmacromolecules.

Unit III. i. Cytoskeleton: Organization and role of microtubules and microfilaments.Implications in flagellate and other movements.

ii. **Plant vacuole:**Tonoplast membrane, ATPases, transporters, as storageorganelle.

Unit IV. Chloroplast and Mitochondria: Ultrastructure, function and biogenesis. Theorganization of genome and patterns of gene expression.

Unit V. Nucleus: Microscopic and submicroscopic organization. Structure and function ofnuclear Envelope. The ultrastructure of nucleolus and its role in rRNA biosynthesis.

Unit VI. Ribosomes: Structure and site of protein synthesis. Mechanism of translation,details of initiation, elongation and termination. The structure and role of RNA.

Practicals based on Bot-401

1. To determine mitotic Index in different plant materials.
2. Karyomorpholpgical studies from slide/photograph.
3. Induction of mitotic abnormalities through chemical treatment.
4. Determination of chiasma Frequency in plants.
5. Fluorescence staining with FDA for cell viability and cell wall staining with calcoflour.
6. Demonstration of-SEM and TEM organelles.
7. Demonstration of acid phosphataes and succinic dehydrogenase activity in plants.
8. Localization of nuclear DNA by using Feulgen as a DNA specific stain.

BOT-402

Molecular Biology

Unit I. Cell signaling: Signal transduction, signaling pathways, second messengers, cAMP,genetic disorders ; due to the G protein defect. Lipid derived second messengers.Receptor tyrosine kinase and signaling pathway. Molecular biology of signaling.

Unit II. Other cellular organelles: Structure and functions of micro bodies,Golgi apparatus, Lysosomes and Endoplasmic reticulum.

Unit III. Proteinsorting: Targeting of proteins to organelles. Translocation of secretaryproteins across the ER membrane. The post translational modifications in RER.

Unit IV. Cell Cycle and its molecular aspects: Control mechanism, the role of cycline andcycline dependent kinases, Retinoblastoma and E_2F proteins. Cytokinesis and cell plateformation. Mechanism of programmed cell death (Apoptosis) and Senescens.

Unit V. Molecular Cytogenetics

i. Nuclear DNA Content: The C-value paradox, the COT value curve & its significance

ii. **Restriction mapping**: Concept and techniques, multigene families and their evolution.

iii. Computer assisted chromosome analysis, chromosome micro-dissection and micro cloning.

Unit VI. Laboratory Techniques: Microscopy, SEM & TEM,Ultracentrifugation, fractionation,Electrophoresis, PCR, GISH, FISH and Immunochemical techniques. The flow cytometry and confocal microscopy in karyotype analysis.

Practicals based on BOT-402

1. Demonstration of native and SDS PAGE profiles of seed proteins.
2. Isolation of plant DNA and its quantitation by spectrophotometric method.
3. Isolation of DNA and preparation of Cot curve.
4. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
5. Isolation of RNA and its quantitation by spectrophotometric method.
6. Separation of plant RNA by agarose gel electrophoresis and visualization by ethidium bromide staining,
7. Demonstration of Western blotting.
8. Estimation of seed proteins by Lowry's method.

Suggested Readings (For BOT-401 & 402 Theory)

1. Lewin, B. 2000, Genes VII, Oxford University Press, New York.

2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D.I 999.Molecular Biology of the cell. Garland Publishing, Inc. New York.

3. Wolfe, S.L. 1993. Molecular and cellular biology. WodsworthPublishing Company, California, U.S. A.

4. De, D.N. 2000. Plant cell vacuoles. An introduction. CSIRO Publication,Collingwood, Australia.

5. Kleinsmith, I.J. and Kish, V.M. 1995. Principles of Cell and MolecularBiology (End Edition). Harper Collins College publishers, New York, U.S.A.

6. Lpdish, H., Berk, A., Zipursky, S.Z., Matsudaira, P., Baltimore, D. and Darnell,J., 2000. Molecular Cell Biology. (4^{th}Edition). W.H. Freeman and company, New York, U.S.A.

Review Journals

1. Annual review of plant physiology and molecular biology.

2. Current advances in Plant Sciences.

3. Trends in Plant Sciences.

4. Nature reviews: Molecular and Cell Biology.

Suggested Readings (For Course BOT401and 402 Practicals)

1. Click, B.R. and Thompson, J.E. 1998. Methods in Plant Molecular biology and biotechnology. CRCPress, BOCA RBTON Florida.

2. Glover, D.M. and Hames, B.D. (Eds.) 1995. DNA cloning I: A practical approach, Core techniques,first edition, TASIRL Press al Oxford University Press, Oxford.

3. Gunning B.E.S. and Steer, M.W. 1996. Plant cell biology, structure and function. Jones and BartletPublishers, Boston, Massachusetts.

4. Hackett, P.B., Funchs, J.A. and Messing, J.W. 1998. An Introduction to recombinant DNAtechniques: Basic experiments in gene manipulation. The Benjamin Cummings PublishingCompany, Inc. Memno Park, California.

5. Hall, J.L. and Moore, A.L. 1983. Isolation of membranes and organelles from plant cells. AcademicPress, London, U.K,

6. Harris, N. and Opataks, K. J. 1994. Plant Cell Biology: A practical approach. IRL Press at OxfordUniversity Press, Oxford, U.K.

7. Shaw, C.H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

BOT 403

(Biology and Diversity of Algae, Fungi and microbes)

UNIT- I. Algae:

- Introduction of phycology with special reference to Indian work.
- Algae in diversified habitats (Terrestrial, fresh water, marine)
- Criteria used in classification of algae, pigments, reserve food and flagella; and important systems of classification of algae.
- A general account of thallus organization, reproduction and life history of algae.
- Study of important groups of algae with reference to General account, cell structure and method of reproduction in
    - **Cyanophyta -** *Nostoc* and *Oscillatoria.*
    - **Chlorophyta**- salient features of Volvocales, Oedogonials and zygnematales (Desmids)
    - **Xanthophyta -** *Botridiuim, vaucheria.*
    - **Bacillariopyta -** *Diatoms.*
    - **Phaeophyta -** *Ectocarpus*.
    - **Rhodophyta -** *Batrachospermum.*
- Algal blooms, Role of Algae in human welfare, bio fertilizer.

UNIT- II. Fungi:

General Characters, Classification.

- Economic importance of fungi in medicine, Agriculture (Biopesticide an biofertilizer), food (SCP. Mushrooms)
- Fungi as plant pathogen – General account of different groups and type study of fungi as pathogen.
    - Mastigomycotina - *Phytophora, albugo,*
    - Zygomycotina –*Rhizopus*,
    - Ascomycotina – *Claviceps, Erysiphae,*
    - Basidiomycotina – *Puccinia, Ustilago,*
    - Deuteromycotina – *Alternaria, Fusarium, Cercospora, Helminthosporium*.

UNIT- III. Bacteria:

General characters, ultrastcture, classification, koch's postulates, archaebacteria and eubacteria.

- Role of agrobacterium in GM crops.
- Citus canker.
- Angular leaf spot of cotton.

UNIT- IV. Phytoplasma: General Account, ultrastructure and economic importance

- Grassy shoot of sugarcane.
- Little leaf of brinjal.

UNIT- V. Viruses: General account, ultrasturcture and economic importance of viruses.

- TMV
- Papaya leaf curl.

Practicals: Based On BOT 403

(Biology and Diversity of Algae, Fungi and microbes)

Algae:

01. Collection and study of algae from different localities, Identification up to generic level.

02. Morphological study of algal forms: *Microsystis, Oscillatoria, Lyngbya, Nostoc, Anabacna,Scytonema, Tolypothrix, Rivularia, Gloeotrichia, Cahthrix, Chlamydomonas, Pandorina, Eudorina, Volvox, Hydrodictyon, Scenedesmus, Pedistruium, Ulothrix, Ulva, Odeogonium, Cladophora, Pithophora, Draparnaldia, Draparnidiopsis, Coleochaete, Cosmarium, Closterium, Caulerpa, Acetabularia, Chara, Nitella, Botrydium, Vaucheria, Pinnularia, Navicula, Fragillaria, Ectocarpus, Diciyota, Fucus, Batrachospermum, Polysiphonia, Corallina.*

Fungi and microbes:

01. Principal and working of instruments.

02. Preparation of Media, strains and Isolation of Bacteria and Fungi from soil and infected plant tissues and pure culture.

03. Gram staining of bacteria.

04. Morphology and Taxonomy of following fungi - *Albugo, Phytophthora, Mucor, Rhizopus, Plasmopara, Sclerospora, Taphrina, Phyllochora, ClavicepsChaetomium, Puccinia, Ustilago, Sphacelotheca, Agaricus, PotyporusVolveriella, Cyaihus, Lycoperdon, Geaster, Alternaria, Aspergillus, Penicilliuin, Helminthosporium, Cercospora, Curvularia, Fusarium, Rhizoctonia, Coltetotrichutn, Phoma.*

05. Growth of Fungi on liquid and solid media — *Fusarium* and *Helminthosporium.*

06. Study of bacterial plant diseases - Citrus canker, Angular leaf spot of cotton, soft rot of fruits.

07. Study of Phytoplasma diseases - Little leaf of brinjal, Sesamumphyllody, Grassy shoot of sugarcane.

08. Study of viral plant diseases - Papaya mosaic, Tomato leaf curl, Yellow vein mosaic of Bhindi.

09. Collection and submission of fungal, viral, phytoplasma and bacterial diseases of plants.

Suggested Readings on BOT 403 Algae:

1. Chapman V.J. & DJ. Chapman (1983) The Algae, The MacMillan Press Ltd., London.

2. Desikachary T.V. (1959) Cyanophyta, 1CAR, New Delhi.

3. Fritsch F.E. (1961) The Structure and Reproduction of the Algae, Vol. I & H, CambridgeUniversity Press, London.

4. KumarH.D. (1988) Introductory Phycology, Affiliated East-West Press Pvt. Ltd., New Delhi.

5. Prescott G. W. (1969) The Algae: A Review, Thomas Nelson .and Sons Ltd., Melbourne.

6. Round F.E. (1981) The Ecology of Algae, Cambridge University Press, London.

7. Smith G.M. (1950) The fresh water algae of the United states, McGrawIIill Hoc Co., New York.

8. Vijayraghavan&SunitaKumari (1995) Chlorophyta, Bisen Singh M. P. Singh, Dehra Dun.

Suggested Readings — (Fungi and microbes)

1. U. Sinha and SheelaShrivastava (1985) An Introduction to Bacteria, Vikas Publishing House Pvt. Ltd., New Delhi.

2. Burgey's Manual of Systematic Bacteriology, Vol. 1-4(1986-1989) Williams & Wilkins, Baltimore.

3. J.P, Verma (1992) The Bacteria, Malhotra Publishing House, New Delhi,

4. A.J. Salle (1974) Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

5. K.G.Hardy (1987) Plasmids - a Practical Approach, 1RL Press, Oxford, Washington D.C.

6. Bruce A. Voyles (2002) The Biology of Viruses, McGraw Hill, Boston.

7. LuriaS.E., J.E. Darnel!, D. Baltimore & A. Campbell (1978) General Virology, John Wiley *& Sons,* New York.

8. E.W. Mester, C.E. Roberts, M.M. Pearsall and B. J.McCarth- General Microbiology, Holt, Renehart& Winston, New York.

9. Powar&Daginawala (2004) General Microbiology Vol. II, Himalaya Publishing House, Mumbai.

10. R,F. Boyd (1984) General Microbiology, Times Mirror/Mosby College Publishing St. Louis.

11. S.B. Biswas & .Amrita Biswas (1993) An Introduction to Viruses, Vikas Publishing House Pvt. Ltd., New Delhi.

12. V.K. Gupta & M,K. Behl (1994) Indian Plant Viruses & Mycoplasma, Kalyani Publishers, Ludhiana.

13. S.P. Raychoudhari& T. K. Nariani (1977) Virus & Mycoplasma Diseases of plants in India, Oxford & IBH Publishing Co., New Delhi.

14. K.B. Deshpande& P.B, Papadiwal (1979) A Laboratory course in Bacteriology, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.

15. P.B. Papdiwal (1980) Biotechniques, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.

16. Alexopoulous C.J., C.W.Mims& M. Blakwel (1996) - Introductory Mycology, John Wiley & Sons Inc.

17. Dube H.C. (1994) - An Introduction to Fungi ,Vikas Publishing House, New Delhi.

18. Sharma P.O. (2000) - Microbiology and plant pathology, Rastogi Publication, New Delhi.

19. Mukadam D.S. (1997) 'The Illustrated Kingdom of Fungi', Aksharganga Publication, Aurangabad.

20. Mukadam D. S. (2004) - Modern Topics in Fungi, Saraswati Printing Press, Aurangabad.

21. Rangaswaini G. & A. Mahadevan (2001) - Diseases of Crop Plants in India., Prentice Hall of India, New Delhi.

BOT 404

(Taxonomy of Angiosperms)

UNIT- I: Angiosperms: Definition, its characteristic features and probable causes of theirevolutionary success. Taxonomy: Definition, scope, principles, aims and objectives oftaxonomy. History of Botanical Explorations in Maharashtra with special reference to Marathwada.

UNIT- II: Phylogeny of Angiosperms: A general account of origin of Angiosperms with reference to timeand place and possible ancestors: euanthial theory (Bennettitales, Caytoniales, Cycadales)and pseudanthial theory (Pentoxylales, Glossopteridae).

UNIT- III: Criteria used for classification; phases of plant classification and brief history on account ofartificial, natural, phylogenetic systems of classifications with special reference to Benthamand Hooker, Cronquist'ssystem, Takhtajan's system and Broad outline of APG III (2009) system of classification and itsmerits and demerits.

UNIT-IV: Botanical Nomenclature: Concept of nomenclature, Binomial nomenclature and itsadvantages, formation of code, Melbourne Code 2011, Principles of International Code of Nomenclature of Algae, Fungi and Plants (ICN), ending of taxa names, Typification.Taxonomic literature: Flora, manuals, monographs, periodicals, dictionaries, indices,journals, pictorial encyclopedias and books.

UNIT-V: Taxonomic evidences: Morphology, anatomy, embryology, palynology, cytology, phyto-chemistry and numerical taxonomy. Taxonomic tools: Serological and moleculartechniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer anddata bases for identification of plants with the help of website). Herbarium Techniques,Major herbaria of the World and India. Contributions of Herbarium BAMU.

UNIT-VI: Causes of variations in population; Speciation, Species Concepts; Taxonomic Hierarchy.

UNIT-VII: Angiosperm Families: Nymphaeaceae, Hydatellaceae, Magnoliaceae, Papaveraceae, Malvaceae, Sapotaceae, Apiaceae, Asteraceae, Arecaceae and Poaceae.

Practicals Based on BOT-404

TAXONOMY OF ANGIOSPERMS

1. Morphology: Terminologies related to Habit and life span, root, stem, leaves, inflorescence,Flower, fruits.
2. Phytography: preparation of scientific botanical description of a plant specimen.
3. Study of at least 20 locally available families of flowering plants.
4. Identification of genus and species of locally available wild plants.
5. Preparation of botanical keys at generic level by locating key characters.
6. Knowledge of at least 10 medicinal plant species.
7. Demonstration of the utility for secondary metabolites in the taxonomy of someappropriate genera.
8. Field trips within and around the University Campus, compilation of field notes andpreparation of herbarium sheets of plants.
9. Botanical excursion of about one week duration to any botanically rich location preferableoutside the State.

Suggested Readings

1. Cole, A.J. 1969. Numerical Taxonomy. Academic Press. London.
2. Daris, P.H. and Heywood, V.H. 1973. Principles of AngiospermsTaxonomy. Robert E.KriegerPub. Co. New York.
3. Grant, V. 1971. Plant Speciation, Columbia, University Press, New York.
4. Grant, W.F. 1984. Plant Biosystematics, Academic Press, London.
5. Harrison, H.J. 1971. New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd.,London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub.Ltd. U.K.
7. Heywood, V.H. and Moore, D.M. 1984.CurrentConcepts in Plant Taxonomy, Academic Press,London.
8. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptions in Plant species. Hieman&Co.Educational Ltd. London.
9. Jones S.B. Jr. &Luchsinger,A.E. 1986. Plant Systematics, (2nd Edition) McGraw-Hill Book Co. NewYork.
10. Radford, A.E. 1986 Fundamentals of Plant Systematics. Harper & RawPublications, U.S.A.
11. Soibrig. O.T. &Solbrig D.J. 1979. Population Biology andEvolution. AddisonwesleyPublicating Co. Inc.U.S.A.
12. Stebbins, G.L. 1974 Flowering Plant- EvolutionAbove Species Level. EdwardArnold Ltd,.London.
13.Stace,C.A. 1989. Plant Taxonomy and Biosystamatics. (2nd Edition)Edward Arnold,, London.
14. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press,New York.
15. Woodland D.W. 1991. Contemporary Plant Systematies.Prentice Hall, New Jersey.

Semester-II

BOT 405

Cytology and Genetics

Unit I. Chromatin organization:

i. Chromosome structure and packaging of DNA.
ii. Nucleosome organization, DNA Structure (A, B and Z forms)
iii. Organization of centromere and telomere.
iv. Karyotype analysis and the banding patterns.
v. Special types of chromosomes- Polytene, Lampbrush, B-chromosome and sex chromosomes.
vi. Molecular basis of chromosome pairing.

Unit II. Structural and Numerical alterations in chromosomes:

i. The origin, meiosis and breeding behaviour of duplication, deficiency, inversion, translocation heterozygotes, haploids, aneuploids and autopolyploids.

ii. The allopolyploids and evolution of major crop plants.

Unit III. Mutation:

i. Spontaneous and induced mutations.

ii. Physical and chemical mutagens.

iii. Molecular basis of gene mutations.

iv. Transposable elements and mutation induced by transposons.

v. Site directed mutagenesis.

Unit IV.DNA damage and repair mechanism.

i. DNA damage and repair mechanism.

ii. Initiation of cancer at cellular level. Proto-oncogenes and oncogenes.

Unit V. Cytogenetics of aneuploids and structural heterozygotes:

i. Effect of aneuploids on plant phenotypes.

ii. The use of monosomics and trisomics in chromosome mapping of diploid and polyploid species.

iii. The breeding behavior and genetics of structural heterozygotes.

iv. The complex translocation heterozygotes.
v. Robertsonian translocation.
vi. B-A translocation.

Unit VI. Genetics of prokaryotic and eukaryotic organelles:

i. **Phage and Bacterial Genetics** —mapping of the bacteriophage genome, genetic recombination in phage, transformation, transduction and conjugation in bacteria

ii. Genetics of mitochondria and chloroplast, cytoplasmic male sterility.

iii. Gene fine structure. Cis-trans test, introns and their significance, RNA splicing.
iv. Regulation of gene expression in prokaryotes and eukaryotes.

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Practical Based on 405

1. Induction of polyploidy in plants using colchicine. Different methods of application of colchicine.
2. Isolation of biochemical mutants following physical and chemical mutagenic
3. Isolation of chlorophyll mutants following physical and chemical mutagenic treatments.
4. Isolation of morphological mutants following physical and chemical mutagenic treatments.
5. Karyotype analysis in any two plant species.
6. Meiosis of complex translocation heterozygotes.
7. Meiotic behaviour of monosomy in plants & its effect.
8. Meiotic behaviour of trisomy in plants and its effect.
9. Mitotic/ meiotic chromosomal behaviour in mutagen treated materials.
10. Orcein and Feulgen staining of the polytene chromosomes of Chironomus.
11. Study of chromosome pairing and disjunction in translocation heterozygote.
12. Utilization of banding technique for identification of chromosomes in karyotype.

Suggested Readings :

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. I989. Molecular Biology (Ed.) Garland Publishing Inc. New York.
2. Atherly, A. G., Girton, J. R. and McDonald, J. F. 1999. The Science of Genetics. Saunders College USA.
3. Burnham, C. R. 1962. Discussions in Cytogenetics, Burgess Publishing Co., Minnesota.
4. Busch. H. and Rothblum, L. 1982 Volume X. The cell nucleus: DNA part A, Academic Press.
5. Hartl, D. L. and Jones E. W. 1998. Genetics: Principles and Analysis (4^{ih} Ed.) Jones and Barew Publishers, Massachusetts, USA.
6. Khush, G. S. 1973. Cytogenetics of Aneuploids, Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology; Concepts and Experiments, John Wiley and Sons Inc. USA.
8. Lewin, B. 2000. Genes VII. Oxford University Press, New York, USA. Lewis, R. 1997. Human Genetics: Concepts and applications (2^{nd} Ed),WCB, McGraw Hill, USA.
9. Malacinski, G. M. and Friefelder, D. 1998. Essentials of Molecular Biology (3^{rd} Ed.), John and Bartlet Publishers Inc. London.Russel, P. J. 1998. Genetics (5^{th} Ed) The Benjamin / Cummings Publishing Company, Inc. USA.
10. Snustad, D. P. and Simmons, M. J. 2000. Principles of Genetics (2^{nd} Ed.), John Wiley and Sons Inc. USA.

BOT 406

Plant Development & Reproduction

Plant Development

Unit I. **i. Meristems:** Organization of shoot and root apical meristem, various theories, Cytological and Molecular analysis of SAM, control of tissue differentiation especially Xylem and Phloem.

ii. Tissue systems: Differentiation and functions of different tissue systems such as epidermis, parenchyma, chlorenchyma, sclerenchyma, laticifers and glands.

Unit II. **i. Vascular tissues:** Origin, structure and functions Xylem and Phloem elements and their taxonomic significance, Wood development in relation to Environment.

Unit III. **i. Leaf:** Growth and differentiation, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

ii. Root: Initiation and development; lateral roots, root hair, root microbe Interaction.

Plant Reproduction

Unit IV. i. **Flower:** Structure and development

ii**Pollination:** Types of pollination, attractions and rewards of pollination, pollination mechanism and vectors, breeding systems, structure of pistil, pollen interaction and fertilization.

Unit V. **i. Male gametophyte:** Structure of anthers, micro-sporogenesis, role of tapetum, male sterility, pollen germination, pollen tube growth and development, pollen storage, pollen allergy, pollen embryos.

ii. Female gametophyte; Ovule development, magasporogenesis, organization of the embryo sac. Structure of the embryo sac.

Unit V. **i. Seed development and fruit growth:** Double fertilization,Endosperm development, Embryogenesis, Ultra-structure and nuclear cytology; Development of dicot and monocot embryos, poly-embryony, apomixes, embryo culture.

Practicals Based on BOT-406

1. Dermatology - trichomes and stomata and leaf anatomy of *Nerium,Terminalia*etc.
2. Mechanical tissues (Collenchyma, Sclerenchyma, Stone cells and Xylem) , Secretary tissues (Mucilage Canals, Resin canals, Nectaries, and oil glands), laticifers (Latex cells and Vessels).
3. Vascular tissues and its constituents by sections and maceration, wood anatomy, TS, TLS and RLS
4. Abnormal secondary growth in *Dracaena, Bignonia, Aristolochia, Achyranthus, Nyctanthus, Salvadora, Beta, Mirabilis, Tinospora.*
5. Study of microsporogenesis and gamtogenesis in sections of anthers.
6. Examination of modes of anther dehiscence and collection of pollen grains for
7. Microscopic examination (maize, grasses, *Crotolaria, Tradescantia, Brassica, Petunia, Solanum*etc.)
8. Test for pollen viability using stains and *in vitro* pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
9. Estimation of percentage and average pollen tube length *in vitro*
10. Pollen storage, pollen pistil interaction, *in vitro* pollination.
11. Study of ovules and embryo sacs.
12. Field study of types of flowers and pollination mechanism. .
13. Study of nuclear and cellular endosperms.

Suggested readings

Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge.

Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.

Chopra, V.L. (2001), 'Plant Breeding, Field Crops', Oxford, BH Pvt. Ltd, New Delhi.

Chopra, V.L. (2001), 'Plant Breeding; theory and practice', Oxford I BH Pvt. Ltd.

Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom

Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.

Cutter, E.G. 1978 Plant Anatomy - Experiments and interpretations' Part I and II, Edward Arnold

Dickinson WC (2000).Integrative Plant Anatomy, Harcourt Academic Press, USA.

Esau, K, 1965. "Plant Anatomy" (Second edition; 7th reprint 1991), Wiley Eastern, New Delhi.

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Richards AJ (1986) Plant Breeding System, George Allen and Unwin.

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Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publishers.

Shivanna, K.R. and John, B.M. (1985), 'The angiosperm pollen structure and function', Willey Eastern Ltd., New York.

Shivanna, K.R. and Rangaswamy, N.S. (1992), 'Pollen Biology: A laboratory manual', Springer Verlag, Berlin.

Shivanna, K.R. and V.K. Sarobney, (Ed) 'Pollen Biotechnology for crop production and

Sleeves, T.A. and Sussex, LM.1989, 'Patterns in plant development *(*7^{th}edition) Cambridge Press, Cambridge.

BOT 407

Biotechnology

Unit I.Biotechnology: Basic concept, Historical, principles of tissue culture, Cellular totipotency, Discoveries of Plant Growth hormones in brief review, Contribution of Sir Gottlieb Haberlandt, Development of Tissue culture as a technique, Scope and Importance.

Unit II.Introduction to tissue culture: Tissue culture laboratory, Equipment's in Tissue culture laboratory, Preparation of Media, Media composition, Plant Growth Regulators and their Role, selection of media for specified applications, Selection of explant, Sterilization, Sterilizing agents, initiation of tissue culture

Unit III. Cellular totipotency: Media for initiation of callus, dynamics of callus growth, measurement of growth, organogenesis and factors controlling it, genome instability in reaction to morphogenesis, somaclonal variation and its applications.

Unit IV. Cell and organ culture: Plant organ culture; shoot tip, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, factors influencing embryogenesis, suspension culture in stationary and stirred tank reactors, isolation of single cells and their culture, measurement of growth,

Unit V.Practical approaches of single cell culture: Somatic embryogenesis, protoplast isolation, regeneration of protoplasts and protoplasts fusion, Synthetic seeds, generation of cybrid and hybrids, cryopreservation of plant cells.

Unit VI. **Applications of tissue culture:** Applications in agriculture and Horticulture, Application in Forestry, Application of Tissue culture in pharmaceutical industry. *In situ* and *ex-situ* conservation.*In vitro* mutagenesis and its application. Production of transgenic plants

Unit. VII. Recombinant DNA technology: Gene cloning, Vectors, Role of *Agrobacterium*, Gene cloning techniques - Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra sonication and Pollen Mediated gene transfer.

Practicals based on 407

1. Equipment's required in Tissue culture Lab
2. Media preparation
3. Sterilization of media
4. Sterilization of explant.
5. Explant Culture.
6. Anther culture
7. Pollen culture,
8. Micropropagation.
9. Embryo rescue technique.
10. Somaclonal variation.
11. *In vitro* mutation.
12. Isolation of plant protoplasts and viability testing.
13. Protoplast fusion by PEG.
14. Tissue culture of Horticultural plant Banana.
15. Tissue culture of Medicinal plant.

Suggested readings:

1. Henry, R.J. Practical application of plant molecular Biology, Champman and Hall
2. Kalyankumar De. Introduction to Plant Tissue culture,
3. Bhojwani, Plant Tissue Culture.
4. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. 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.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
10. Susan R. Barnum (1998). *Biotechnology: an introduction*. Thomson Brooks/cole.
11. George Acquaah (2005). *Understanding biotechnology*. Pearson.
12. Biotechnology; P.K. Gupta

BOT 408

Plant Physiology and Metabolism

Unit I. Plant water relations: Water Potential, Absorption and Transpiration, Stomatal Physiology, Active and passive transport of solutes, Phloem loading and unloading, source-sink relationship, Physiology of plants under water stress.

Unit II. Enzyme: Nomenclature, Properties and classification of enzymes, Mechanism of Enzyme action, regulation of enzyme action, isoenzymes.

Unit III. Photosynthesis: Light and dark reactions, pigments and mechanism of light absorption, Photosystem I and II, Emerson enhancement effect, C3, C4 and CAM pathways, significance of C4 and CAM pathways, photorespiration, Photo synthetic productivity.

Unit IV. Respiration: Glycolysis, TCA cycle and its role in synthesis of bio-molecules Mitochondrial electron transport, oxidative phosphorylation, Pentose phosphate pathway, cyanide resistance, Bioenergetics principles.

Unit V. Nitrogen Metabolism: Nitrification and denitrification, Nitrate assimilation, Biological nitrogen fixation, Biosynthesis of amino acids - reductive animation and trans amination, Protein synthesis, classification of amino acids and proteins, amphoteric nature and zwitter ions, structure of proteins, protein denaturation, Isolation and purification of proteins.

Unit VI. Lipid Metabolism: Fatty acids, lipids, triglycerides, Saponification, oxidation of Fatty acids- alpha and beta oxidation.

Unit VII. Plant Growth: Growth curve, growth analysis, plant growth regulating substance (PGRS), Gibberellins, Cytokinesis, Abscisic acid, Ethylene, role of PGRs in agriculture.

Unit VIII. Plant Development: Physiology of flowering, Phytochrome, flowers induction, Seed germination and dormancy, senescence and aging, stress physiology, vernalization and abscission.

Practicals Based On BOT- 408

1. Separation of chlorophyll pigments by paper and thin layer chromatography,
2. Spectrophotometry - Absorption spectrum for chlorophyll pigments extracted from green leaves.
3. Estimation of total chlorophyll, chlorophyll 'a' and chlorophyll b
4. Estimation of reducing sugars using Fehling's solution A and B.
5. Isolation of starch from potato.
6. Isolation of pectin form fruit rinds.
7. Hydrolysis of starch by acid and crude enzyme extract from germinating seeds.
7. Effect of temperature on permeability.
8. Difference between C3 and C4 plants- chlorophyll content and leaf anatomy.
9. Estimation of Ascorbic acid from fruit juice and germinating seeds.
10. Estimation of proline in normal plant and that under stress.
11. Separation of amino acids by paper and thin layer chromatography.
12. Chemical tests for protein.
13. Estimation of protein by Lawry's method.
14. Estimation of protein by Biuret method.
15. Isoelectric point of casein.
16. Immobilization of enzymes using sodium alginate.
17. Preparation of leaf protein concentrate (LPC) by heat coagulation method.
18. Iodine number of fat.
19. Saponification number of fat.
20. Growth analysis - RGR, NAR and LAI.
21. Biostatistics: mode, median, mean, range, mean deviation, standard deviation, coefficient of variation (C.V.) in simple or classified data (frequency distribution).

Suggested Readings :

1. Plant physiology: F.N. Salisbury and C.W. Ross, CBS Publishers and Distributors, New Delhi.
2. Principles of Biochemistry, A.L. Lehninger, CBS Publishers and Distributors, New Delhi.
3. Plant physiology: R.G.S. Bidwell, Mac Millan Publishers Co., New York.
4. Advnced plant physiology, M.B. Wilkins, English Language Book Society, London.
5. Principles of plant physiology, Bormer, J. and Galston, A.W.
6. Introductory plant physiology, Noggle G.R. and Fritz, G.S., Prentice Hall, USA.
7. Plant Water Relationships, Slyter, R.O. Academic Press, New York.
8. Plant physiology, D. Hess, Narosa Publishing House, New Delhi.
9. Elementary Biochemistry, Mertz, E.T. Vakils, Fetter and SimsonsPvt Ltd. Mumbai.

10. Essentials of Biological Chemistry, Fairley, J.L. and Kilgon, G.L., Earr west Press Pvt. Ltd., Delhi.

11. Plant physiology, Devlin, R.M. and Hostan, F.H., CBS Publishers and Distributors, New Delhi.

12. Plant Physiology, S.C.Datta, Willey Eastern Limited, Culcutta.

13. Plant Physiology, S. Mukharji, A.K.Ghosh, New Central Book Agencies, Kolkatta.

14. An Introduction to Biometry, A.M.Mungikar, Sarswati Printing Press, Aurangbad.

15. Biostatical Analysis, A.M.Mungikar, SarswatiPrinting Press, Aurangabad.

16. Laboratory Manual in Biochemistry, Jayraman, J., New Age International Publishers, Mumbai.

17. Experiment in Plant Physiology, D. BajrachrysNarosa Publishing House, New Delhi.

Semester-III

BOT 501: BIOLOGY & DIVERSITY OF BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS

Unit I. Bryophytes: Systems of classification, distribution, Economic importance. Habitat, external and internal morphology, reproduction, gametophytes and sporophytes,phylogeny and interrelationships of the orders: Sphaerocarpales, Takakiales, Marchantiales and Jungermanniales,Anthocerotales, Sphagnales, Andreales and Bryales.

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

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

Unit IV. 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 V. Paleobotany: Introduction, Contributions of Prof. BirbalSahani, Geological time scale, Fossils and fossilization, Continental drift/ plate tectonics.

PRACTICALS BASED ON BOT 501: BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS

i. **Vegetative Organization:***Marchantia, Riccia, Anihoceros, Sphagnum,Polytrichum.*

ii. **Anatomical Organization:** *Marchantia, Cyathodium, Anthoceros, Sphagnum.*

iii. **Archegonia and Antheridia and their Organization:***Riccia, Marchantia, Anthoceros,Sphagnum.*

iv. **Sporophytes***: Riccia, Marchantia, Pellia, Anthoceros, Funaria, Sphagnum,Polytrichum.*

Pteridophytes: Morphological and anatomical studies of1) *Psilotum*2) *Lycopodium.* 3) *Selaginella*, 4) *Isoetis*, 5) *Equisetum*,6) *Ophioglossum*, 7) *Osmunda*, 8) *Gleichenia*, 9) *Pteris*, 10) *Adianium*,11) *Marselia*, 12) *Salvinia*, 13) *Azolla*and additional forms/speciescollected during study tour.

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

SUGGESTED READINGS:

Agashe, S. N. (1995) Paleobotany, Oxford & IBH, New Delhi

Bir, S. S. (2005) Pteridophytes their Morphology, Cytology, Taxonomy and Phylogeny.Today & Tomorrow's Printers and Publisher.

Biswas, C. and B. M. Johri (2004) The Gymnosperms, Narosa Publishing House, New Delhi

Campbell, C. J. (1940) Evolution of land Plants, Stanford University Press.

Coulter J. M. and C. J. Chamberlain (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad

Eames, A. J. (1974) Morphology of Vascular Plants- lower groups, Tata Me Graw-Hill Publishing Co. New Delhi.

Foster, A. S. & F. M. Gifford (1967) Comparative morphology of vascular plants, Freeman Publishers, San Fransisco.

Kakkar, R. K. and B. R. Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.

Kashyap S. R. (1932) Liverworts of Western Himalayas and the Plains.Vol. I & II, The University of Panjab, Lahore.

Parihar, N. S. (1991) Bryophytes, Central Book Dept., Allahabad.

Parihar, N. S. (1976) The biology and morphology of the pteridophyta, Central Book Depot, Allahabad.

PuriPrem (2005) Bryophytes Morphology, Growth and Differentiation- Pulisher- Atmaram and Sons New Delhi

Rashid, A. (1976) An introduction to pteridophyta, Vikas Publishing House Ltd., New Delhi.

SambamurtyA. V. S. S. , (2005) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, Today & Tomorrow's Printers and Publishers

Sharma O. P. (2002) Gymnosperms, PragatiPrakashan, Meerut.

Sharma P. N. and Sahni K. C. (2005) Gymnosperms of India and Adjacent Countries Publisher-Bhishan Singh Mahendra Pal Singh, Dehradun

Tewari, Shiv Datt and GiriBala Pant (2005) Bryophytes of Kumaun Himalaya. Publisher-Bhishan Singh Mahendra Pal Singh- Dehradun

Siddiqui K. A. (2002) Elements of Paleobotany, KitabMahal, Allahabad.

Smith, G. M. (1976) Cryptogamic Botany - Vol. II, Tata Me Graw-Hill Publishing Co. Ltd. New Delhi.

Sporne, K. R. (1976) Morphology of Pteridophyta. Hutchinson University Library, London.

BOT 502: 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 IIi.**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 in relation to air, water and soil. Use of fertilizer, pesticides andother 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, Bioindicator 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.

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

ii. Biological DiversityAct 2002; Forest Conservation Act 19, Wild Life Protection Act 1972 and relatedinternational conventions.

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 SO_2 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:

Ambasht, R. A. (1990) A text book of Plant Ecology, Students Friends & Co., Varanasi.

Benny Joseph (2005) Environmental Studies, Tata McGraw Hill Publishing Co., Ltd., New Delhi.

Conklin, A. R. Jr. (2004) Field Sampling: Principles and Practices in Environmental Analysis. CRC Press.

Fahey, T. J. and Knapp, A. K. (2007) Principles and Standards for Measuring PrimaryProduction. Oxford.

Grant, W. E. and Swannack, T. M. (2008) Ecological Modeling. Blackwell.

Koromondy, E. J. (2005) Concepts of Ecology.4th Ed. Prentice Hall of India, New Delhi.

Muller, Dombosis, D. and H. Ellenberg (1974) Aims and methods of vegetation ecology, Wiley, New York.

Mungikar, A. M. (2003) Biostatistial Analysis. Saraswati Printing Press. Aurangabad.

Odum E. P. (1971) Fundamentals of Ecology, Saunders, Philadelphia.

Rajagopalan, R. (2005) Environmental studies, Oxford University Press, New Delhi.

Ramkrishna, P. S. (2001) Ecology and Sustainable Development. National Book Trust, New Delhi.

Sharma, P. D. (2001) Ecology and Environment, Rastogi Publications. Meerut.

Stiling, Peter. (2004) Ecology- Theories and Applications.4th Ed. Prentice Hall of India, New Delhi.

Trivedi, P. R. (1999) Encyclopedia of Ecology and Environment. Vol. 1 - 10, Indian National Green Party, New Delhi.

Trivedi. R. K., Goel P. K., Trisal C. L. (1998) Practical Methods in Ecology and Environmental Science: Enviro-media Publisher, Karad

Wilkinson, D. M. (2007) Fundamental Processes in Ecology: An Earth system Approach. Oxford.

Wyse Jackson, P. S. and Sutherland, L. A. (2000) International Agenda for Botanic Gardens in Conservation, Botanic Garden Conservation International (BGCI) UK

Yadav, Manju (2003) Ecology. Discovery Publishing House, New Delhi.

WEBSITES:

www.nbaindia.org

www.envfor.nic.in

www.moef.nic.in

www.bgci.org.uk

www.bsi.nic.in

www.bsienvis.nic.in

www.nbpgr.ernet.in

www.maharashtrastatebiodiversityboard.gov.in

www.iucn.org

www.iucnredlist.org

www.iucnredlistecosystems.org

www.conservation.org

www.biodiversity-a-z.org

BOT-521- (Elective-A)

Crop genetics and Plant breeding-I

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.

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

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

BOT- 521 – (Elective B)

Plant Pathology-I

Unit I. Plant disease diagnosis: Field observations, laboratory investigations, isolation of plant pathogen and purification, Koch's postulates; identification of plant pathogens.

Unit II Classification of Plant diseases: Based on crop plants, symptoms, causal organisms.

Unit III. 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, Ergot of bajra. .

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

a) **Basidiomycotina:** Loose smut of wheat, Bunt of wheat, kernel 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 V. Symptoms, etiology and disease cycle of diseases caused by Deuteriomycotina:

Early blight of potato and tomato leaf spot caused by *Alternaria* on brinjal, crucifers, Tikka disease of groundnut, Helminthosporiurn leaf spot on Rice; Blast of Rice, Red rot of sugarcane, Die back of chili, Wilt of Pigeaon pea, Panama disease of Banana, Blight of gram, *Rhizoctonia*stem rot of crops

BOT-521 (Elective C)

TAXONOMY OF ANGIOSPERMS-I

UNIT-I: **Characteristic features of angiosperms;** aims and objectives of taxonomy, functions and phases of taxonomy; taxonomy as synthetic discipline (passing remarks)

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

UNIT-III: **Taxonomic hierarchy:** it's major, minor and intraspecific 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

UNIT-IV: **Concept of taxonomic character:** analytical and synthetic, qualitative and quantitative, genetically and environmentally controlled, good and bad character, character weighing, taxonomic coefficient

UNIT-V: **Phylogenetic relationship:** Primitive and advanced characters, monophyletic, paraphyletic and polyphyletic, homology and analogy, parallel and convergent evolution, plesiomorphic and apomorphic characters. **Cladistics:** Operational Taxonomic Units (OTU) characters and coding, measuring of similarity, cladograms.

BOT 521 (Elective D)

Advanced Plant Physiology and Biochemistry-I

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: chlorophylls, phycobiliproteins, phenolics, sterols, alkaloids, carotenoids, phytochrome, anthocyanine, phenolics, sterols, alkaloids, porphyrins, organic acids, possibilities of isolating these chemicals for human welfare.

Unit III.Principles and applications of colorimeters, photometry flame photometers, spectrophotometry, chromatography (ion exchange, affinity, thin layer, high pressure liquid) gel filtration, electrophoresis, electro focusing and ultracentrifugation,

Unit IV. Application of 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,

BOT 522 – (Elective –A)

Crop genetics and plant breeding - II

Unit I Heterosis breeding: 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 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. i. 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.

ii. 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) Interspecific, intergeneric gene transfers, methodology, problem and remedial measures, c) Man made species.

Unit-V i. 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.

BOT- 522 – (Elective B)

Plant Pathology-II

Unit I. i. Agents of infections and diseases: Biotic agents - bacteria, viruses, fungi, mycoplasma, nematodes.

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

Unit II.Phytoplasma diseases: Symptoms and disease cycle of little leaf of brinjal; Sesamumphylody, witches broom diseases, Grassy shoot of sugarcane.

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

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

BOT-522 (Elective C)

TAXONOMY OF ANGIOSPERMS-II

UNIT-I: **The 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:** Scientific names: legitimate name, illegitimate name, 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.

UNIT-V: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per Engler's system of classification:

a) Magnoliales, b) Alismatales, c) Liliales, d) Asparagales,

e) Poales, f) Zingiberales g) Ranunculales h) Malphighiales

i) Fabales j) Cucurbitales

BOT 522 (Elective D)

Advanced Plant Physiology and Biochemistry - II.

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 crapping hydro carbon, plants biomathylation biogas, biogas plants, biogas production from soils city 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 fraetionation: The GGF system and advantages of GCF. Mechanical fractionation, plants suitable for GCF, Machinery recommended for mechanical fractionation, products, pressed crop residue (PCR) Juice, leaf protein concentrate and deproteinized Juice (DPJ)

Unit V. Green Crop Fractionation: Use of PCR in animal nutrition preparation of silage, silage fermentation, use of leaf juice as a milk replacer, 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 replacer of tissue culture media, LPC compared with algal protein SCP, the possibility of increasing protein productivity through green crop fractionation. Bidkin Process.

Practicals Elective -1 course – BOT 521 and BOT 522 (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.
8. Aneuploid analysis in crop plants.
9. Induction of polyploidy in crop plants.
10. Study of seed protein profile by native and SDS-PAGE.
11. Estimation of oils from edible oil crops.
12. Estimation of leaf proteins, seed proteins in diploids and polyploids.
13. 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.
14. Study of mutagenesis data published in different journals and arriving at logical conclusions by providing theoretical reasons.
15. Designing of filed experiments.

Suggested readings

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.Chrispels 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

Practical Course based on BOT 521 and BOT 522 (Elective B)

1. Collection and preservation of diseases specimens.
2. Symptomology, histopathology of disease given in theory.
3. Virulence test for pathogens.
4. Visits to fields for study of diseases.

Suggested readings

1.Agrios, G. N. (1969) Plant Pathology, Academic Press, New York.

2. Rangaswami, G. and A. Mahadevan (2001) Disease of crop plants in India, Prentice Hall of India, Pvt. Ltd., New Delhi.

3.Gupta, V. K. and V. S. Paul (2001) Disease of vegetable crops. Kalyani Publ. Ludhiana,

4. Gupta, V. K. and S. K. Sharma (2000) Disease of fruit crops, Malyani Publ. Ludhiana.

5. Raychaudhari, S. P. and T. K. Nariani (1977) Virus and Mycoplasma disease of Plants in India. Oxford and IBK Publ. Corp., New Delhi.

6. Bos, L. (1999) Plant viruses, unique and intriguing pathogens. Backhugs Publ. Leiden.

7. Rangaswami, G. and S. Rajagopalan (1973) Bacterial Plant Pathology, T. N. Agri. Uni., Coimbatore.

Practicals based on BOT-521C & BOT-522 (Elective C)

TAXONOMY OF ANGIOSPERMS I & II

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.
9. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
10. 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.*
11. Several One-day botanical excursions to botanically rich locations.
12. Botanical excursion of about one week to any botanically rich location preferable outside the State.

SUGGESTED READINGS:

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) KoeltzVesentific 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.

Practical Based on BOT 521 & BOT 522 (Elective-D)

1. Estimation of B - carotene with column chromatography.
2. Estimation of reducing sugars by Folin – Wu tube.
3. Estimation of cellulose by cramption and Maynord 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.
11. Estimation of ash acid soluble / insoluble ash, Nitrogen free extracts and total carbohydrates.
12. Estimation of cell wall constituents, ADF, NDF, cellulose, hemicellulose, lignin etc.
13 Estimation of calcium by titration method.
14. Estimation of phosphorus by SubbaRao and Fiske Method,
15. Growth analysis: AGR, RGR, NAR, LAR, LAI, CGR and LAD.
16. The process of GCF and extractability of dry matter and Nitrogen.
17. Preparation of LPC, by heat coagulation, acid coagulation and fermentation.
18. Preparation of cytoplasmic and chloroplastic LPC by differential heat coagulation.
19. Preparation of TCM using DPJ and Inoculation of explant.

Suggested Readings

1) Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.

2) Mukharji, S. and Ghosh, A. K. Plant Physiology. New Central Book Agencies, Kolkatta.

3) Noggle, G. R. and Fritz, G. S. Introductory plant physiology, Prentice Hall, U. S. A.

4) Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation, Continental Prakashan, Pune - 30.

5) ICAR Handbook of Agriculture, ICAR, New Delhi.

6) Mungikar, A. M. Bibliography of leaf protein in Marathwada University.

7) Pine, N. W. (1971) Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U. K.

8) Telek, H. and Graham, LT. (1983) Leaf protein concentrates, AVI, Publishing Co., USA.

Service Course- I

(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, Phytohormonesand 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. Kalyankumar De. Introduction to Plant Tissue culture,
2. Bhojwani, Plant Tissue Culture.
3. Dubey. R. C. a Textbook of Microbiology
4. Montell. S. H. Mathews, J. A., Meker, R. A. Principles of Plant Biotechnology.
5. 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.
6. Purohit Plant Tissue Culture
7. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
8. Shaw, C. H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
9., R. H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
10. Rajdan : An introduction to plant tissue culture.
11. SandhyaMitra: Genetic engineering.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
B. Sc. I, II & III Year Botany Curriculum
(SEMESTER PATTERN)
Course Structure

Class	Paper No	Title of Paper	Credits	Lectures	Marks
B. Sc. I	**SEMESTER - I**				
	I	Diversity of Cryptogams - I	3	45	50
	II	Morphology of Angiosperms	3	45	50
	III	Practical based on Paper - I	1.5	45	50
	IV	Practical based on Paper - II	1.5	45	50
	SEMESTER – II				
	V	Diversity of Cryptogams - II	3	45	50
	VI	Histology, Anatomy and Embryology	3	45	50
	VII	Practical based on Paper - V	1.5	45	50
	VIII	Practical based on Paper - VI	1.5	45	50
B. Sc. II	**SEMESTER – III**				
	IX	Taxonomy of Angiosperms	3	45	50
	X	Plant Ecology	3	45	50
	XI	Practical based on Paper - IX	1.5	45	50
	XII	Practical based on Paper - X	1.5	45	50
	SEMESTER – IV				
	XIII	Gymnosperms and Utilization of plants	3	45	50
	XIV	Plant Physiology	3	45	50
	XV	Practical based on Paper - XIII	1.5	45	50
	XVI	Practical based on Paper - XIV	1.5	45	50
B. Sc. III	**SEMESTER – V**				
	XVII	Cell Biology and Molecular Biology	3	45	50
	XVIII (A) XVIII (B) XVIII (C) XVIII(D)	Diversity of Angiosperms - I OR Plant Breeding and Seed Technology OR Plant Pathology OR Biotechnology	3	45	50
	XIX	Practical based on Paper - XVII	1.5	45	50
	XX	Practical based on Paper - XVIII	1.5	45	50
	SEMESTER – VI				
	XXI	Genetics and Biotechnology	3	45	50
	XXII (A) XXII (B) XXII (C) XXII (D)	Diversity of Angiosperms - II OR Economic Botany OR Microbiology and Disease Management OR Bioinformatics	3	45	50
	XXIII	Practical based on Paper - XXI	1.5	45	50
	XXIV	Practical based on Paper - XXII	1.5	45	50

Note: For theory paper: 1credit = 15 periods/lectures,
For Practical paper 1credit = 30 periods/lectures

B. Sc. I Year (Theory)
Semester - I
Paper I
(Diversity of Cryptogams - I)

Lectures - 45

Unit - 1 **Credit - 1**

1.1 **Viruses:**

General characters, classification based on host, economic importance, TMV – structure and multiplication (04)

1.2 **Mycoplasma:**

General characters (01)

1.3 **Bacteria:**

General characters, ultra structure, classification based on shape, reproduction, economic importance (05)

1.4 **Cryptogams:**

General characters, classification according to G.M. Smith up to class level (01)

1.5 **Lichens:**

General characters, nature of association, forms of thalli, economic importance, structure and reproduction in *Usnea* (04)

Unit – 2 **Credit - 1**

2. **Algae:**

2.1 General characters, classification according to F.E. Fritsch (1935) up to the class level, economic importance. (02)

2.2 Systematic position, occurrence, thallus structure, reproduction vegetative, asexual and sexual, (excluding development of sex organs) and graphic life cycle with respect to following types:

i. Cyanophyceae – *Nostoc* (02)
ii. Chlorophyceae – *Chara* (03)
iii. Xanthophyceae – *Botrydium* (02)
iv. Phaeophyceae – *Sargassum* (03)
v. Rhodophyceae – *Batrachospermum* (03)

Unit – 3 **Credit -1**

3. **Fungi:**

3.1 General characters, classification according to Alexopoulous and Mims (1979) up to the class level, economic importance (03)

3.2 Systematic position, occurrence, structure of mycelium, reproduction - asexual, sexual and graphic life cycle with respect to the following types:

i) Oomycetes – *Albugo* (03)
ii) Zygomycetes – *Mucor* (02)
iii) Ascomycetes – *Eurotium* (02)
iv) Basidiomycetes – *Agaricus* (03)
v) Deuteromycetes – *Cercospora* (02)

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B. Sc. I Year (Theory)
Semester - I
Paper - II
(Morphology of Angiosperms)

45L

Unit – 1 **Credit 1**

1.1- Basic body plan of flowering plant, modular type of growth, diversity of plant forms – Herbs, Shrubs, Trees, Climbers; annuals, biennials and perennials. (02)

1.2 Morphology of vegetative organs:

a) **Root:** Characteristics, functions, regions of root, types – tap and adventitious, modification of root for storage, mechanical support (stilt root) and vital functions (Pneumatophore). (04)

b) **Stem:** Characteristics, functions, modification – underground, sub aerial and aerial (03)

c) **Leaf:** Parts of typical leaf, phyllotaxy, types (simple and compound), diversity in shape and size, venation and modifications of leaf. (06)

Unit – 2 **Credits 2**

2. Morphology of reproductive organs:

2.1 Inflorescence: Racemose, cymose and special types (05)

2.2 Flower: Definition, parts of typical flower, forms of thalamus, androphore, gynophore, gynandrophore, insertion of floral whorls on thalamus (hypogyny, perigyny and epigyny), structure, function and modification of calyx, corolla, androecium, gynoecium, aestivation and placentation (15)

2.3 Fruit: Types of fruits (06)

2.4 Fruit and Seed dispersal strategies. (04)

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B. Sc. I Year (Practical)
Semester - I
Paper – III
(Diversity of Cryptogams - I)

45L
Credits – 1.5

Note: Study of specimens of Bacteria, Algae, Fungi, through temporary mounting, permanent slides, field work and biovisual aids. Observation of disease symptoms in hosts infected by Fungi may be observed

1. Study of simple and compound microscope
2. Virus: Tobacco Mosaic Virus
3. Gram staining in bacteria, forms of Bacteria
4. **Algae:**
   a) *Nostoc*
   b) *Chara*
   c) *Botrydium*
   d) *Sargassum*
   e) *Batrachospermum*
5. **Fungi:**
   a) *Albugo*
   b) *Mucor,*
   c) *Eurotium*
   d) *Agaricus*
   e) *Cercospora*
6. **Lichens:** Form - Crustose, Foliose, Fruticose; *Usnea.*

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B. Sc. I Year (Practical)
Semester - I
Paper – IV
(Morphology of Angiosperms)

45L
Credits - 1.5

Note: Study of the following with the help of temporary mountings, permanent slides, charts, models, specimens and biovisual aids.

1. **Study of root and its modifications :**
   a) Tap root
   b) Adventitious root
   c) Storage roots
   d) Stilt root
   e) Respiratory root.
2. **Study of stem and its modifications :**
   a) Underground stem
   b) Sub aerial stem
   c) Aerial stem
3. **Study of leaf and its diversity**:
   a) Types of leaf (Simple, Compound)
   b) Shape and size
   c) Venation
   d) Phyllotaxy
   e) Modifications
4. **Study of inflorescence**:
   a) Racemose
   b) Cymose
   c) Special
5. **Study of flowers:**
   a) Typical flower (*Hibiscus* / *Datura*)
   b) Hypogynous, Perigynous and Epigynous
   c) Aestivation
   d) Forms of corolla – cruciform, papilionaceous, infundibuliform and bilabiate
   e) Parts of typical stamen, adhesion and cohesion.
   f) Parts of typical carpel and placentation

6. **Study of flowers with respect to pollination mechanism:**
   a) Calotropis
   b) Ocimum
   c) Salvia
   d) Helianthus
   e) Ficus
   f) Clitoria
7. **Study of fruits:**
   a) Simple: legume, capsule, caryopsis, achene, drupe, berry.
   b) Aggregate: an etaerio of berries, an etaerio of follicles
   c) Composite fruit: sorosis, syconus

Note for paper III and IV:

Candidate shall submit the following at the time of practical exam.

1. Certified laboratory record book.
2. Field note book / Tour report.
3. Collection of specimens from algae and fungi.

In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teacher. Collection of rare flowering and non flowering plants should be avoided during excursion. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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B. Sc. I Year (Theory)

Semester – II

Paper - V

(Diversity of Cryptogams - II)

45 L.

Unit- 1 **Credit 1**

1. Bryophytes:

1.1 General characters of bryophytes, classification as per G. M. Smith (02)

1.2 Systematic position, occurrence, thallus structure (external and internal), reproduction -vegetative, asexual, and sexual (excluding developmental stages), graphic life cycle and alternation of generations of the following types:

a) Hepaticopsida – *Marchantia* (07)

b) Bryopsida – *Funaria* (06)

Credits 2

2. Pteridophytes:

2.2 General characters of Pteridophytes, classification as per G. M. Smith (02)
Systematic position, occurrence, external and internal structure of sporophyte and gametophyte, reproduction (excluding developmental stages), graphic life cycle and alternation of generations of the following types:

a) Psilopsida – *Psilotum* (03)

b) Lycopsida – *Lycopodium, Selaginella* (12)

c) Sphenopsida – *Equisetum* (06)

d) Pteropsida – *Marsilea* (07)

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B. Sc. I Year (Theory)

Semester - II

Paper - VI

(Histology, Anatomy and Embryology)

45 L.

Unit – 1 **Credit - 1**

Histology:

a) Types of tissue:

i. Meristematic tissue – Meristem, structure and types based on origin and position. (03)

ii. Permanent tissues: Simple, Complex and Secretary (06)

iii. Epidermal tissues: Trichomes and Stomata (02)

b) Histological organization of root and shoot apices (02)

c) Various theories of cellular organization (02)

Unit – 2 **Credit 1**

Anatomy:

a) Primary structure of root, stem and leaf of Monocot (Maize) and Dicot (Sunflower) (07)

b) Secondary growth in root and stem of Dicot (Sunflower) (04)

c) Wood anatomy: Growth rings, heart wood and sap wood (02)

d) Periderm: Origin, structure and functions. (02)

Unit – 3 **Credit 1**

Embryology:

a) Structure of anther, microsporogenesis and development of male gametophyte (03)

b) Structure and types of ovule, megasporogenesis and development of female gametophyte (Polygonum type). (04)

c) Pollination -Mechanism, types and agencies. (02)

d) Double fertilization and its significance (01)

e) Development of Dicot embryo (Crucifer type). (01)

f) Structure, development and types of endosperm. (02)

g) Structure of Dicot and Monocot seed (02)

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B. Sc. I Year (Practical)

Semester - II

Paper - VII

(Diversity of Cryptogams II)

45L
Credits – 1.5

Note: Study of specimen of Bryophytes, and Pteridophytes through temporary mounting, permanent slides, field work and biovisual aids.

a) Bryophytes:
   i. *Marchantia*
   ii. *Funaria*

b) Pteridophytes:
   i. *Psilotum*
   ii. *Lycopodium*
   iii. *Selaginella*
   iv. *Equisetum*
   v. *Marsilea*

*****

B. Sc. I Year (Practical)

Semester - II

Paper - VIII

(Histology, Anatomy and Embryology)

45L
Credits – 1.5

Histology:

1. Meristem: root apex and shoot apex
2. Permanent tissues – simple,complex and secretory
3. Epidermal tissues: trichomes and stomata

Anatomy:

1. Anatomy of young dicot (Sunflower) and monocot (Maize) root. (Double stained permanent slide preparation)
2. Anatomy of young dicot (Sunflower) and monocot (Maize) stem. (Double stained permanent slide preparation)
3. Anatomy of dicot (Sunflower) and monocot (Maize) leaf. (Double stained permanent slide preparation)

Embryology:

1. Study of T.S. of anther
2. Structure of ovule (anatropous), types of ovules
3. Study of Dicot and Monocot seed (embryo)

Note for Paper VII and VIII:

Candidate shall submit the following at the time of practical exam.

1. Certified laboratory record book.
2. Field note book and Tour report.
3. Collection of specimens
4. Permanent slides of root stem and leaf.

In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teacher. Collection of rare flowering and non flowering plants should be avoided during excursion. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty Of Science

Pattern of Theory Question Paper

B.Sc. I YEAR (BOTANY)

Semester I

Paper I

(Diversity of Cryptogams – I)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Algae) 10

or

Describe in brief:
a. Short answer type ……(Algae)
b. Short answer type ……(Algae)

Q.2. Long answer type question ……..……(Fungi) 10

or

Describe in brief:
a. Short answer type ……(Fungi)
b. Short answer type ……(Fungi)

Q.3. Write short notes on: (Any two) 10
a. Short note (Bacteria, Viruses, Mycoplasma)
b. Short note (Algae)
c. Short note (Fungi, Lichen)

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty Of Science
Pattern of Theory Question Paper
B.Sc. I YEAR (BOTANY)
Semester I
Paper II
(Morphology of Angiosperms)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Root, Stem, Leaf) 10

or

Describe in brief:
a. Short answer type ……(Root, Stem, Leaf)
b. Short answer type ……(Root, Stem, Leaf)

Q.2. Long answer type question ……..……(Inflorescence, Flower, Fruit) 10

or

Describe in brief:
a. Short answer type ……(Inflorescence, Flower, Fruit)
b. Short answer type ……(Inflorescence, Flower, Fruit)

Q.3. Write short notes on: (Any two) 10
a. Short note (Root, Stem)
b. Short note (Leaf)
c. Short note (Flower, Fruit).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. I YEAR (BOTANY)
Semester I
Paper III
(Diversity of Cryptogams -I)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify, classify and describe any two algae from the given mixture 10
Q.2. Identify, classify and describe the given specimen of fungi 10
Q.3. Identify and describe the specimen A, B, C and D as per the instructions 10
(A-Algae, B-Fungi, C-Lichen and D-Bacteria / viruses)
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report and field report 10

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. I YEAR (BOTANY)
Semester I
Paper IV
(Morphology of Angiosperms)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify and describe the structure, modification and pollination mechanism in the given flower 10
Q.2. Identify and describe the structure / modification in the given specimens 'A' and 'B' (Root, stem and leaf) 10
Q.3. Identify and describe the specimens C, D, E and F as per the instructions 10
(C-inflorescence, D-Flower, E-Flower and F-Fruit)
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report and field report 10

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty Of Science
Pattern of Theory Question Paper
B.Sc. I YEAR (BOTANY)
Semester II
Paper V
(Diversity of Cryptogams – II)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Bryophytes) 10

or

Describe in brief:
a. Short answer type ……(Bryophytes)
b. Short answer type ……(Bryophytes)

Q.2. Long answer type question ……..……(Pteridophytes) 10

or

Describe in brief:
a. Short answer type ……(Pteridophytes)
b. Short answer type ……(Pteridophytes)

Q.3. Write short notes on: (Any two) 10
a. Short note (Bryophytes)
b. Short note (Pteridophytes)
c. Short note (Pteridophytes)

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty of Science

Pattern of Theory Question Paper

B.Sc. I YEAR (BOTANY)

Semester II

Paper VI

(Histology, Anatomy and Embryology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Anatomy) 10

or

Describe in brief:
a. Short answer type ……(Anatomy)
b. Short answer type ……(Anatomy)

Q.2. Long answer type question ……..……(Histology, Embryology) 10

or

Describe in brief:
a. Short answer type ……(Histology, Embryology)
b. Short answer type ……(Histology, Embryology)

Q.3. Write short notes on: (Any two) 10
a. Short note (Histology)
b. Short note (Anatomy)
c. Short note (Embryology)

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. I YEAR (BOTANY)
Semester II
Paper VII
(Diversity of Cryptogams - II)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify, classify and describe the given specimen (Bryophytes) on the basis of external and internal features. 10
Q.2. Identify, classify and describe the given specimen (Pteridophytes) on the basis of external and internal features. 10
Q.3. Identify and describe the specimen A, B, C and D as per the instructions 10
(A-Bryophytes, B-Pteridophytes C- Pteridophytes and D- Pteridophytes)
Q.4. Submission:
c) Record book, viva - voce and collection 10
d) Tour report and field report 10

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. I YEAR (BOTANY)
Semester II
Paper VIII
(Histology, Anatomy and Embryology)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Prepare a double stained permanent preparation of the given specimen. Identify and describe with a well-labelled diagram. 12
Q.2. Identify and describe the structure of Trichome / Stomata in the given leaf. 08
Q.3. Identify and describe the specimens A, B, C and D as per the instructions. 10
(A-Histology, B - Histology, C - Anatomy and D - Embryology)
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report, field report. 10

*****

B. Sc. II Year (Theory)
Semester III
Paper -IX
(Taxonomy of Angiosperms)

(45L)
Credit - 1

Unit :1

1. Salient features, origin and evolution of Angiosperms (03)
2. Bentham and Hooker's system of classification upto series level, its merits and demerits (03)
3. Taxonomy in relation to anatomy, embryology, palynology, ecology and cytology (03)
4. Concept of Binomial Nomenclature and its advantages (02)
5. Concept of genus, species and epithet. (02)
6. Herbaria and Botanical Gardens. (02)

Unit:2 **Credits :2**

Study of the following families: systematic position , salient features, floral formula, floral diagram, common examples and their economic importance (30)

i. Annonaceae
ii. Malvaceae
iii. Leguminosae
    Fabaceae (Papilionaceae)
    Caesalpiniaceae
    Mimosaceae
iv. Apocynaceae
v. Solanaceae
vi. Acanthaceae
vii. Lamiaceae (Labiatae)
viii. Nyctaginaceae
ix. Liliaceae
x. Poaceae (Gramineae)

*****

B.Sc.II Year(Theory)
Semester - III
Paper - X
(Plant Ecology)

45 L

Unit: 1 **Credit: 1**

Plant and environment:

A)Climatic factors – a) Light as an ecological factor, global radiation and photosynthetically active radiation (02)

b) Temperature as an ecological factor (02)

c) Water as an ecological factor, physicochemical properties of water (03)

B)Edaphic factor –

Soil formation -soil profile, physicochemical properties of soil, major soil types of India, soil erosion and soil conservation (08)

Unit:2 **Credit:1**

1. Response of plants to water

Morphological, physiological and anatomical response of plants to water – hydrophytes, xerophytes, halophytes and epiphytes (12)

2. Phytogeography: (03)

Biogeographical regions of India, vegetation types of India

Unit: 3 **Credit:1**

1. Community ecology:

Community characteristics -frequency, density, life forms, biological spectrum (06)

1. Ecosystem:

structure -biotic and abiotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles-nitrogen and phosphorus. (09)

*****

B.Sc. II year (Practical)
Semester - III
Paper - XI
(Taxonomy of Angiosperms)

45 L
Credits:1.5

Angiosperms:

Study of locally available plants of the following families :

1. Annonaceae
2. Malvaceae
3. Leguminosae
    a) Fabaceae (Papilionaceae)
    b) Caesalpiniaceae
    c) Mimosaceae
4. Apocynaceae
5. Solanaceae
6. Acanthaceae
7. Lamiaceae (Labiatae)
8. Nyctaginaceae
9. Liliaceae
10. Poaceae (Gramineae)

*****

B.Sc.II year (Practical)
Semester - III
Paper - XII
(Plant Ecology)

45 L
Credit :1.5

1. Study of morphological and anatomical adaptations in hydrophytes – *Hydrilla*, *Eichhornia*, *Typha* and *Nymphaea* .
2. Study of morphological and anatomical adaptations in xerophytes -*Aloe*, *Nerium, Casuarina.*
3. Study of morphological adaptations in halophytes -Pneumatophore, Stilt roots
4. Study of morphological and anatomical adaptations in epiphytes
5. Study of vegetation by quadrat method
6. Estimation of Importance Value Index (IVI) of grassland ecosystem on the basis of relative frequency, relative density and relative abundance.
7. Determination of water holding capacity of different soils
8. Study of meteorological instruments -Rain gauge, Hygrometer, Barometer
9. Determination of percent leaf area injury of different infected leaf samples
10. Estimation of salinity of different water samples
11. Determination of pH of different soils by pH papers/universal indicator/pH meter.

Note for paper XI and XII:

Candidate shall submit the following at the time of practical exams: Certified laboratory record book, Field note book, Tour report and Collection of specimens.

In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teachers. Collection of rare flowering and non flowering plants should be avoided during excursion. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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B. Sc. II Year (Theory)
Semester - IV
Paper - XIII
(Gymnosperms and Utilization of Plants)

45 L
Credits 1.5

Unit:1

Gymnosperms:

1. Salient features, classification as per Sporne 1965, economic importance (02)
2. Geological time scale, fossilization, types of fossils, *Lyginopteris*, fossil fuels (04)
3. Contributions of Prof. Birbal Sahani (01)
4. Study of morphology, anatomy, reproduction (excluding developmental stages) and graphical representation of life cycle of the following types:
   a) Cycadales – *Cycas* (08)
   b) Coniferales – *Pinus* (08)

Unit:2 **Credits:1.5**

Utilization of Plants:

1. Domestication of plants and their centers of origin (02)
2. History, origin, cultivation, harvesting, improved varieties and economic importance of the following plants: (15)
   i. Food plants – Wheat, Jowar
   ii. Sugar – Sugarcane
   iii. Fibers -Cotton, Jute
   iv. Vegetable oils – Groundnut, Sunflower
   v. Beverages – Tea, Coffee
3. Botanical name, family name and economic importance of the following plants: (05)
   i. Medicinal plants – *Aloe vera, Withania somnifera, Curcuma longa, Vitex negundo*
   ii. Timber and Gum – Teak, Neem, Babul, Sisham
   iii. Cosmetics and Perfumes – Rose, Mogara, Tuberose
   iv. Spices – Clove, Black pepper, Cumin, Coriander, Cinnamon

*****

B. Sc. II Year (Theory)
Semester IV
Paper XIV
(Plant Physiology)

45 L

Unit:1 **Credit 1**

1. **Plant water relations:**
   a) Diffusion, osmosis, plasmolysis and imbibition (02)
   b) Water absorption and ascent of sap (Transpiration pull theory) (03)
   c) Transpiration – Definition, types -cuticular, lenticular and stomatal, structure of stomata, mechanism of opening and closing of stomata (starch – sugar hypothesis) (02)
2. **Mineral nutrition:**
   a) Macro and microelements: roles and deficiency symptoms of N, P, K, Mg, Ca, Fe, Zn, Bo, Mo.
   b) Mineral uptake – passive (ion exchange theory) and active (carrier concept) (05)
3. **Translocation of solutes:**
   Mass flow hypothesis, protoplasmic streaming theory, Source and sink relationship (03)

Unit:2 **Credits 1**

1. **Enzymes :**:
   Chemical nature – holoenzyme ,apoenzyme, prosthetic group, cofactor and coenzyme, properties , nomenclature, classification basedon type of reactions, mechanism of enzyme action (06)
2. **Growth**: Definition, Phases of Growth, Sigmoid growth curve. (02)
3. **Growth regulators**:
   Discovery, stucture, roles and practical applications of Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene (07)

Unit:3

Credit 1

1. **Photosynthesis:**
   Definition, ultra structure of chloroplast, photosynthetic pigments, Light reactions -Hill reaction, red drop and Emerson enhancement effect, two pigment systems (PS I, PS II), photophosphorylation – cyclic and noncyclic, Z-scheme; Dark reactions -C3, C4 and CAM pathways (08)
2. **Respiration:**
   Definition, Ultra structure of mitochondria, types of respiration, Glycolysis, TCA Cycle, Electron transport system, alcoholic and lactic acid fermentation. (07)

*****

B.Sc. II year (Practical)
Semester IV
Paper XV
(Gymnosperms and Utilization of plants)

45L

Credit:1.5

Gymnosperms:

a) Cycas

i. Habit, young leaf, bulbils, male cone, microsporophyll, megasporophyll, pollen grains, mature seed.
ii. Study through permanent slides-Normal root (T.S.). Stem (T.S.), Ovule (L.S.)
iii. Study through hand section-Coralloid root (T.S.), Rachis (T.S.), Leaflet (T.S.)

b) Pinus

i. Habit, long and dwarf shoot, scale leaves, foliage leaves, male cone, female cone, pollengrains (W.M.), winged seed.
ii. Study through hand sections and permanent slides Root (T.S.), Stem (T.S.), Needle (T.S.)
iii. Study through permanent slide - T.L.S. & R.L.S. of stem, L.S. of male cone, L.S. of female cone

Palaeobotany:

a) Types of fossils (Specimens)
b) *Lygynopteris* (Specimen / Permanent slide)

Utilization of plants :

a) Food plants – Study of the morphology, structure,and histochemical tests of food storing tissue in Jowar & Wheat
b) Histochemical test of lignin and cellulose
c) Vegetable oils – hand section of Groundnut & Sunflower Seed and staining of oil droplets by Sudan III
d) Study of the sources of Timber, Gum, Medicinal plants, Cosmotics and Perfumes
e) Study of Black pepper, Clove, Cinnamon, Cumin, Coriander
f) Field notebook, specimen collection, and tour report.

*****

B.Sc. II year (Practical)
Semester IV
Paper XVI

(Plant Physiology) 45L

Credits:1.5

1. Osmosis by egg membrane and potato osmoscope
2. Plasmolysis in *Tradescantia* leaves
3. Effect of different conc. of organic solvents on membrane permeability
4. Determination of water potential of any tuber
5. Detection of mineral elements in plant ash
6. Digestion of starch by amylase
7. Detection of enzyme activity : oxidase, peroxidase, catalase and dehydrogenase
8. Separation of chloroplast pigments by paper chromatography
9. Demonstration of Hill reaction
10. Effect of different intensities of light on photosynthesis
11. Effect of different colors of light on photosynthesis
12. Fermentation by Kuhnes fermentation vessel
13. Isolation of starch
14. Isolation of pectin
15. Estimation of total and reducing sugars in fruit juice by Fehling solution
16. Separation of amino acids by paper chromatography
17. Effect of IAA and Gibberellins on seed germination

Note for Paper XV and XVI

Candidate shall submit the following at the time of practical examination: Certified laboratory record book. Field report , Tour report.and Collection of specimens.

In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teachers. Collection of rare flowering and non flowering plants should be avoided during excursion. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of the Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of the Department.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty Of Science

Pattern of Theory Question Paper

B.Sc. II YEAR (BOTANY)

Semester III

Paper IX

(Taxonomy of Angiosperms)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY)
Semester III
Paper X
(Plant Ecology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.2. Long answer type question ……..……(Unit 3) 10

or

Describe in brief:
a. Short answer type ……(Unit 3)
b. Short answer type ……(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. II YEAR (BOTANY)
Semester III
Paper XI
(Taxonomy of angiosperms)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify giving reasons and describe the specimen 'A'.Give floral formula and floral diagram. 10
Q.2. Identify, classify giving reasons and describe the specimen 'B'.Give floral formula and floral diagram. 10
Q.3. Identify and describe the specimen C, D, E and F as per the instructions (C- and D - Morphology, E- and F - Economic importance) 10
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report and field report 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. II YEAR (BOTANY)
Semester III
Paper XII
(Plant Ecology)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify and describe morphological and anatomical adaptations in the given specimen. Make a temporary preparation of the given specimen. 10
Q.2.Conduct the ecological experiment, record the principle, observation and result (Experiment No. 5,6,7,9,10,11) 10
Q.3. Identify and describe the specimens A, B, C, and D, as per the instructions (Experiment No. 1, 2, 3, 4, 8) 10
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report and field report 10

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty Of Science

Pattern of Theory Question Paper

B.Sc. II YEAR (BOTANY)

Semester IV

Paper XIII

(Gymnosperms and Utilization of plants)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions

ii) All questions carry equal marks

iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:

a. Short answer type ……(Unit 1)

b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:

a. Short answer type ……(Unit 2)

b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10

a. Short note (Unit 1 and 2)

b. Short note (Unit 1 and 2)

c. Short note (Unit 1 and 2)

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY)
Semester IV
Paper XIV
(Plant Physiology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 3) 10

or

Describe in brief:
a. Short answer type ……(Unit 3)
b. Short answer type ……(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 2)
b. Short note (Unit 2)
c. Short note (Unit 2).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. II YEAR (BOTANY)
Semester IV
Paper XV
(Gymnosperms and Utilization of plants**)**

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Make a double stained permanent preparation of the given specimen 'A'
(Gymnosperm). Identify and describe with a well labeled diagram. 10
Q.2. Histochemical tests in given material 'B'
(Protein / Carbohydrate /Lipid / cellulose / Lignin) 10
Q.3. Identify and describe the specimen C, D, E and F as per the instructions 10
(C- and D - Gymnosperms, E- and F- Utilization of plants)
Q.4. Submission:
a) Record book, viva - voce and collection 10
b) Tour report and field report 10

*****

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. II YEAR (BOTANY)
Semester IV
Paper XVI
(Plant Physiology)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q. 1. Make a list of materials required for the physiological experiment allotted to you.
Show it to the examiner, write the procedure and record the readings. 10
(Expt No. 2, 3, 4,5, 6,7 as per practical syllabus)
Q. 2. Make a list of materials required for the experiment allotted to you.
Show results to the examiner. 10
(Expt No. 8,10,11,13,14,15,16 as per practical syllabus)
Q.3. Identify and describe the principle and working in the given experiment
(Experiment No. 1, 9, 12, 17) 10
Q.4. Submission:
a) Record book, viva - voce 10
b) Tour report / project report 10

*****

B.Sc.III Botany (Theory)
Semester -V
Paper XVII
(Cell Biology & Molecular Biology)

(45L)

Unit-1 Credit-1

1. Cell:
   Structure of Prokaryotic cell (Bacterial cell) and Eukaryotic cell (plant cell) (02)
2. Cell wall and cell organelles:
   Structure and functions of cell wall and Cell organelles – Golgi complex, Endoplasmic reticulum, Lysosomes (08)
3. Nucleus:
   Ultra structure, (nuclear membrane, nucleolus, chromatin material, nucleoplasm), Functions of nucleus. (05)

Unit-2 Credit-1

1. **Cell division:** (06)
   a) Cell cycle -G1 phase, S phase, G2 phase and M phase
   b) Mitosis – definition,process and significance.
   c) Meiosis-definition, process and significance.

2. **Nucleic acids:** (09)
   a. DNA: Definition, structure, chemical composition (nitrogenous bases, purines, pyrimidines, nucleosides, nucleotides, phosphate and sugars) Watson and Crick's model, Z - DNA, B - DNA, functions of DNA
   b. Replications of DNA – conservative, semi conservative and dispersive.
   c. RNA: Structure, types and functions

Unit-3 Credit-1

1) Chromosome: (07)
Definition, morphology-size, shape, number, Ultra structure – chromatid, chromonema, chromomere, centromere, kinetochore, secondary constriction, satellite, telomere, heterochromatin, euchromatin, Nucleosome model (Woodlock 1973), chemical composition, Functions of chromosome, Giant chromosomes-polytene and lampbrush chromosome.

2) Chromosomal aberrations : (08)
a) Structural-deletion, duplication, inversion and translocation
b) Numerical: – euploidy and aneuploidy

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B.Sc. III Year (Theory)
Semester – V
Paper XVIII(A)
(Diversity of Angiosperms-I) (45 L)

Unit: 1 **Credit-1**

1. Biodiversity (03)

Definition, concept, origin and evolution

2. Types of biodiversity: (05)

Species, genetic, ecological, cropland and agricultural diversity; biodiversity in India; endemism and hot spots; threatened species, threats to biodiversity

3. Conservation of biodiversity: (07)

Major causes for loss of biodiversity, listing of threatened biodiversity; threatened categories – extinct, endangered, vulnerable, rare and indeterminate. Conservation measures: – ex-situ, and in-situ; biodiversity conservation in India.

Unit -2 **Credit -2**

Phytotaxonomy: (08)

Classification of Angiosperms with special reference to Linnaeus, A. P. de Candole, Bentham and Hooker.

Study of diversity following families with reference to the system of classification of Bentham and Hooker

(22)

1. Magnoliaceae
2. Nymphaeaceae
3. Papveraceae .
4. Brassicaceae
5. Capparidaceae .
6. Rutaceae
7. Rhamnaceae
8. Combretaceae
9. Lythraceae
10. Cucurbitaceae
11. Apiaceae

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B. Sc. III Year (Theory)
Semester -V
Paper: XVIII (B))
(Plant Breeding and Seed Technology) 45L)

Unit -1 **Credits-2**

Plant Breeding :

1. Introduction, history, aims and objectives (02)
2. Domestication, plant introduction and acclimatization (02)
3. Hybridization – history, hybridization procedure. (03)
4. Selection methods -mass selection, pureline selection and clonal selection (04)
5. Hybridization in self pollinating plants (03)
6. Hybridization in cross pollinating plants (03)
7. Heterosis and hybrid vigour (02)
8. Mutation in crop improvement (02)
9. Hybridization programme in Jowar and Cotton (06)
10. Experimental designs and biometrical techniques in plant breeding - Randomized block design, Latin square design, Analysis of variance, Assessment of variability, Simple measures of variability (03)

Unit -2 **Credit-1**

Seed Technology :

1. Seed technology -history, aims and objectives (01)
2. Morphology and anatomy of seed (monocot and dicot seed , endospermic and non endospermic seed) (02)
3. Stages of seed multiplication -
   a. nucleus seed (04)
   b. breeders seed
   c. foundation seed
   d. certified seed
   e. registered seed
   f. truthful seed
4. Seed certification process (02)
5. Stagewise multiplication of foundation and certified seed in Jowar and Cotton (02)
6. Seed processing – drying, cleaning, dressing, bagging, tagging, storage and marketing (02)
7. New techniques in seed technology (02)

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B.Sc. III Year (Theory)
Semester –V
Paper XVIII (C)
(Plant Pathology)

45L

Unit-1 **Credit-1**

Fundamentals of plant pathology:

1. Plant pathology – history, scope, losses due to pathogens, importance and need to study plant pathology (02)
2. Classification of plant diseases on the basis of symptoms and causal organisms – animate and inanimate (03)
3. Plant pathological institutes – IARI (Indian Agricultural Research Institute), ICRISAT(International Crop Research Institute for Semi Arid Tropics) (02)
4. Seed pathology – concept and importance of seed pathology, seed borne pathogens, methods to study seed borne pathogens (03)
5. Study of air borne pathogens: methods and applications (03)
6. Field and laboratory diagnosis of plant disease - Koch's postulates (02)

Unit-2 **Credit-2**

Plant diseases:

Study of the following diseases with respect to symptoms, causal organism, disease cycle and disease management:

1) Cereals:	a. Black stem rust of wheat	(05)
	b. Grain smut of jowar	
	c. Ergot of bajra	
2) Pulses:	a. Wilt of pigeon pea	(04)
	b. Yellow vein mosaic of bean	
3) Vegetables:	a. Late blight of potato	(05)
	b. Little leaf of brinjal	
	c. Black rot of onion (*Aspergillus*)	(04)
4) Oil seeds:	a. Tikka disease of groundnut	
	b. Damping off of mustard	
5) Cash crops:	a. Grassy shoot of sugarcane	(06)
	b. Downy mildew of grapes	
	c. Angular leaf spot of cotton	
	d. Citrus canker	
6) Ornamentals:	a. Powdery mildew of rose	(02)
7) Weeds:	a. Rust of Euphorbia	(02)
8) Trees:	a. *Cercospora* on *Albizzia* fruits	(02)

*****

B. Sc. III Year (Theory)
Semester- V
Paper XVIII (D)
(Biotechnology)

45L

Unit- 1 **Credits -2**

Biotechnology:

1. **Introduction:**
   a. Definition, scope and multidisciplinary nature (05)
   b. Biotechnology in India
2. **DNA structure, replication and recombination:** (05)
   a. Structure of DNA
   b. Replication of DNA, Role of DNA polymerase
   c. Denaturation and renaturation of DNA
   d. Recombination
3. **Recombinant DNA technology**: (15)
   a. Introduction, principles and procedure
   b. Enzymes involved in recombinant DNA technology
   c. Vectors
   d. Southern and Northern blotting technique
   e. Techniques in gene mapping
   f. DNA fingerprinting
   g. PCR
   h. DNA sequencing
   i. Genomics and DNA libraries
4. **Genetic engineering:** (05)
   a. Introduction to transgenic plants
   b. Vectors for gene deliveries
   c. Marker and reporter genes
   d. Role of agriculture in crop biotechnology
   e. Achievements in plant biotechnology

Unit- 2 **Credit- 1**

1. **Plant tissue culture:** (10)
   a. Principles of tissue culture
   b. Terminology in tissue culture
   c. Cellular differentiation and totipotency
   d. Organogenesis and embryogenesis
   e. Protoplast isolation and culture
   f. Meristem culture
   g. Anther culture
   h. Applications of tissue culture
2. **Research projects:** (05)
   a. Human genome project
   b. Plant genome project
   c. DBT Ministry Of Science and Technology.

B.Sc.III Botany (Practical)
Semester -V
Paper XIX
(Cell Biology & Molecular Biology)

45 L
Credit – 1.5

Unit-1

1. Study of the cell structure from onion leaf or *Tradescantia* leaf
2. Preparation of cytological (AA, FAA etc.) fixatives and stains (acetocarmine, aceto-orcein).
3. Study of electron micrographs of viruses, bacteria and cyanobacteria
4. Study of electron micrographs of eukaryotic cell and different cell organelles
5. Preparation of slides for the study of mitosis (root tips of onion)
6. Preparation of slides for the study of meiosis (*Rhoeo*, *Aloe* or onion flower buds)
7. Preparation of idiogram from the given micrograph of karyotype
8. Observation of giant chromosomes in *Chironomous* larvae
9. Preparation of wool models of mitosis, meiosis, cell structure, Chromosome, DNA and RNA.

*****

B.Sc. III Year (Practical)
Semester – V
Paper XX (A)
(Diversity of Angiosperms-I)

45 L

Unit: 1 **Credits-1.5**

1. Study of herbarium
2. Study of analytical characters
3. Preparation of indented and bracketed keys
4. Study of following families:
    1. Magnoliaceae
    2. Nymphaeceae
    3. Papaveraceae
    4. Brassicaceae
    5. Capparidaceae
    6. Rutaceae,
    7. Rhamnaceae
    8. Combretaceae
    9. Lythraceae
    10. Cucurbitaceae
    11. Apiaceae,
5. Mounting of pollen grains (acetolysis method)

Note for paper No. XIX and XX

Students should undertake excursion to ecologically different areas for plant study and submission of at least 20 wild plants at the time of practical examination.

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B. Sc. III Year (Practical)
Semester -V
Paper: XX(B)
(Plant Breeding and Seed Technology)

45 L

Unit -1 **Credits-1.5**

Plant breeding:

1. Study of floral biology of jowar and cotton
2. Demonstration of male sterility in jowar
3. Artificial emasculation and pollination in jowar and cotton
4. Demonstration of hybridization techniques in jowar and cotton
5. Designing of field experiments
6. Visit to plant breeding centre

Seed technology:

1. Study of morphology and anatomy of monocot, dicot, endosprmic and nonendospermic seeds
2. Study of seed germination – observation of normal and abnormal seedlings, germination percentage
3. Blotter test
4. Method of breaking seed dormancy
5. Study of various seed processes – drying, cleaning, dressing, bagging, tapping and marketing
6. Preparation of seed certification tag
7. Viability test (Tetrazolium test)
8. Visit to various seed farms and research centres

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B.Sc. III Year (Practical)
Semester –V
Paper XX (C)
(Plant Pathology)

45L

Unit-1 **Credits-1.5**

1.Study of Koch's postulates – isolation, inoculation and disease development

2.Study of the following diseases with respect to symptoms, causal organism, disease cycle and disease management

1) **Cereals:**
   a. Black stem rust of wheat
   b. Grain smut of jowar
   c. Ergot of bajra
2) **Pulses:**
   a. Wilt of pigeon pea
   b. Yellow vein mosaic of bean
3) **Vegetables:**
   a. Late blight of potato
   b. Little leaf of brinjal
   c. Black rot of onion (*Aspergillus*)
4) **Oil seeds:**
   a. Tikka disease of groundnut
   b. Damping off of mustard
5) **Cash crops:**
   a. Grassy shoot of sugarcane
   b. Downy mildew of grapes
   c. Angular leaf spot of cotton
   d. Citrus canker
6) **Ornamentals:**
   Powdery mildew of rose
7) **Weeds:**
   Rust of Euphorbia
8) **Trees:**
   Cercospora on *Albizzia* fruits

*****

B. Sc. III Year (Practical)
Semester- V
Paper XX (D)
(Biotechnology)

45L

Unit- 1 **Credits -1.5**

1. Principle and working of instruments in biotechnology laboratory - Autoclave / Pressure Cooker, Centrifuge, Hot plate, Water bath, Laminar Air flow, Oven, Microscope, pH Meter, Refrigerator, Magnetic Stirrer, Shaker, Agarose Gel Electrophoresis, Green House etc.
2. Sterilization of glasswares
3. Preparation of sterile media, nutrient broth, PDA, M.S. medium, B5 medium, White medium
4. Isolation of bacteria and fungi from air
5. Demonstration of meristem culture
6. Demonstration of anther culture
7. Separation of amino acids by gel electrophoresis

****

B.Sc.III (Theory)
Semester -VI
Paper XXI
(Genetics and Biotechnology)

45 L
Credit : 1

Unit : 1

1. Mendelism: (04)

i. Introduction -G.J. Mendel
ii. Mendelian principles –Law of Dominance , law of segregation, law of independent assortment, back cross and test cross

2. Interaction of genes: (07)

i. Allelic interaction: incomplete dominance, co dominance, lethal genes and blood group inheritance
ii. Non allelic and non epistatic -comb shapes in fowls
iii. Non allelic and epistatic:
   a) Complementary genes or duplicate recessive epistasis (9:7)
   b) Supplementary genes or recessive epistasis (9:3:4)
   c) Dominant epistatic genes or dominant epistasis (12:3:1)
   d) Duplicate genes or duplicate dominant epistasis (15:1)

3. Sex determination: (04)

i. Chromosomal theory of sex determination
ii. Mechanism of sex determination in man (xx -xy), Drosophila (xx and xy), birds (zz-zw), grasshopper (xx-xo) and genic balance theory in Drosophila
iii. Sex determination in plants – *Melandrium*

Unit : 2 **Credit : 1**

1. Sex linked inheritance: (07)

X, XY and Y linked inheritance:
i) Colourblindness and hemophilia in man
ii) Holandric genes
iii) White eye colour in Drosophila,
iv) Gynandromorphs,

2. Structure and function of gene: (08)

i. Fine structure of gene (Seymour Benzer)
ii. One gene one enzyme hypothesis
iii. Genes and related diseases – phenylketonuria, and alkaptonuria
iv. Detection of genetic diseases –amniocentesis Genetic counseling

Unit: 3 **Credit : 1**

Biotechnology: **(15)**

1. Concept of genetic engineering and recombinant DNA technology
2. Restriction endonucleases, their properties and uses
3. Cloning vectors -plasmids and phage vectors
4. Techniques of genetic engineering -isolation of desired gene, gene cloning, transfer of gene into plants
5. Applications of genetic engineering

*****

B.Sc. III Year (Theory)
Semester – VI
Paper XXII (A)
(Diversity of Angiosperms-II)

45 L

Unit: 1 **Credit-1**

Plant identification: keys, herbaria and botanical gardens (04)
Origin of angiosperms: origin and evolution, Bennettitalean, Ranalian and Caytonial theory (05)
Binomial nomenclature: Principles and rules (03)
Modern trends in taxonomy: (03)
Cytotaxonomy, chemotaxonomy, and numerical taxonomy

Unit: 2 **Credits-2**

1.Phytotaxonomy: (10)
Study of Engler & Plantle ,Hutchinson,Takthajan system of classification

2.Study of diversity of families: (20)

a. Asclepiadaceae
b. Scrophulariaceae
c. Oleaceae
d. Convolvulaceae
e. Verbenaceae
f. Amaranthaceae
g. Euphorbiaceae
h. Orchidaceae
i. Liliaceae
j Commelinaceae

****

B. Sc. III Year (Theory)
Semester- VI
Paper: XXII (B)
(Economic Botany)

45L

Unit -1 **Credit-1**

Origin, morphology, production, cultivation practices, harvesting and uses of crop plants.

a) **Cereals:** Maize, Pearl millet and Rice
b) **Pulses:** Bengal gram, Black gram and Pigeon pea
c) **Oil seed crops:** Soybean, Mustard and Castor

Unit -2. **Credit-1**

a) **Fibre crops:** Jute, Sunhemp and Cotton
b) **Horticultural crops:** Banana, Orange and Mango
c) **Ornamentals:** Rose, Orchids and *Chrysanthemum*

Unit -3. **Credit-1**

a) **Beverages:** Tea and Coffee
b) **Forage crops:** Cowpea, Jowar and Lucerne
c) **Vegetable crops:** Brinjal, Potato, Tomato and Onion
d) **Condiments and Spices:** Cardamom, Black pepper and Chillies

*****

B.Sc. III Year (Theory)
Semester –VI
Paper XXII (C)
(Microbiology and Disease Management)

45L

Unit-1 Credit-1

1. Microbiology

Microorganisms in biological world, their classification and features of different groups (03)

2. **Microbial techniques**:

a. Microscopy – simple, compound and electron microscope

b. Micrometry – Principle, working and uses

c. Staining – common stains used in pathology,their preparation and significance, (cotton blue and Gram's Stain)

d. Sterilization of glasswares and media (06)

3. Culture media for isolating plant pathogen

Industrial application of microorganisms - organic acids, alcohol,milk products, antibiotics and biopesticides (06)

Unit-2 **Credit-2**

Disease management:

1. Preventive methods: field sanitation, use of clean planting material, crop rotation, trap crops, time of sowing, planting distance and tillage (02)

2. Control methods –

a. Seed treatment: concept, objective, traditional and modern methods of seed treatment (02)

b. Soil sterilization: concept, objectives and methods (02)

c. Fungicides: Definition, classification and ideal characteristics of fungicides, study of fungicides with respect to active ingredients, formulations, methods of application, mode of action and uses (08)

i. Sulphur fungicides – Inorganic – Wettable sulphur, Organic – Thirum

ii. Copper fungicides

iii. Mercuric chloride – Agrosan – GN

iv. Heterocyclic nitrogenous compounds – Captan

v. Benzene compounds – Dexon

vi. Antibiotics – Streptomycin and Aureofungin

vii. Systemic – Bavistin and Vitavax

d. Pesticides:Nicotin,Neem and pyrethrum (01)

e. Rhodenticides – Zinc phosphoid (01)

f. Nematicides- Nemagon, Propoxar (01)

g Weedicides- 2,4-D (01)

h. Biological control- definition, need, examples and role (02)

Plant quarantine (01)

3. Control measures and environment: pollution due to chemicals, residual effects, toxicity, safe measures, colour code, antidote, symptoms of

poisoning, precautions in using pesticides (03)

4. Pesticide application equipments: principle and working –pneumatic air pump knapsack sprayer, mist blower and duster, types of nozzles (03)

5. Plant clinic: Concept, objective and need (01)

6. Recent techniques in plant pathology: Genetically modified organisms (GMO's), B.T.Cotton, Pheromones (02)

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B. Sc. III Year (Theory)
Semester- VI
Paper XXII (D)
(Bioinformatics) 45L

Unit- 1 **Credit -1**

1. Introduction to bioinformatics and its applications (03)

2. Sampling, sample size, sampling techniques (03)

3. Data collection and presentation: (05)

a. Types of data

b. Methods of data collection

c. Data presentation - line chart, bar chart, histogram, polygon, ogive curve, pie diagram

4. Measures of central tendency: (04)

a. Mean

b. Median

c. Mode ,

Unit – 2 **Credit-1**

Measures of variability: (05)

a. Mean deviation,

b. Standard deviation

c. Coefficient of variation

d. Standard error

2. Probability, chi-square test, t – test (05)

3. Introduction to computer basics- general characters, types of computer (03)

4. Hardware-input and output devices, CPU, storage devices (02)

Unit – 3 **Credit-1**

1. Software – MSDOS, Windows, Linux, concept of files and folders and directories, (08)
Application software - Word processor, Spread sheet, Presentation, MS-access, html document

2. Networking technology - LAN, WAN, Arpanet, Internet, Web browsing and servers – Netscape navigator, Internet explorer, search engines like yahoo, google etc.Introduction to MEDLINE, CCOD and PUBMED for biological information, Introduction to bioinformatics software - bioperl biojava bioxml (07)

B.Sc. III (Practical)
Semester -VI
Paper XXIII
(Genetics and Biotechnology)

(45 L)

Credits : 1.5

1. Quiz
2. Working out laws of inheritance by using seed mixtures
3. Problems based on gene interaction
4. Problems based on sex linked inheritance

B.Sc. III Year (Practical)
Semester – VI
Paper XXIV (A)
(Diversity of Angiosperms-II)

(45 L)
Credits-1.5

1 . Study of following families:

1. Oleaceae
2. Asclepiadaceae
3. Convolvulaceae
4. Scrophulariaceae
5. Verbenaceae
6. Amaranthaceae
7. Euphorbiaceae
8. Orchidaceae
9. Liliaceae
10. Commelinaceae

2. Mounting of pollen grains (acetolysis method) and measurement of pollen size.
3. Study of different types of stomata and epidermal structures (Trichome)
4. Identification of plants up to species by using flora (Flora of Bombay Presidency/ Flora of Marathwada)
5. Students should undertake excursion to ecologically different areas for plant study and submission of at least 10 wild plants at the time of examination.

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B. Sc. III Year (Practical)
Semester- VI
Paper: XXIV (B)
(Economic Botany) **45L**
Credit-1.5

Economic Botany:

1. Study of morphology, structure and simple histochemical tests of food storing tissues in Maize, Rrice, Jowar, Gram, Pigeon pea, Potato
2. Study of histochemical tests of lignin and cellulose (Jute, Cotton, Sunnhemp)
3. Hand section of Groundnut, Sunflower and staining of oil droplets
4. Study of plantation crops(Tea and Coffee)
5. Study of condiments and spices (Cardamom, Black Pepper and Chillies)
6. Study of horticultural crops (Banana, Orange and Mango)
7. Study of Vegetable crops (Brinjal, Potato, Onion, Tomato)
8. Study of ornamental plants (Rose and *Chrysantemum*)

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B.Sc. III Year (Practical)
Semester –VI
Paper XXIV (C)
(Microbiology and Disease Management)

45L

Credit-1.5

1. Study of fungicides as per theory syllabus
2. Preparation of Bordeaux mixture, burgundy mixture and Bordeaux paste
3. Study of insecticides with respect to active ingredient, colour code, formulation, mode of action, antidote and uses
4. Study of *Trichoderma* culture
5. Study of plant protection equipments –pneumatic air pump, knapsack sprayer, mist blower cum duster
6. Principle and working of autoclave, laminar air flow, Tilak air sampler
7. Use of aerobiological techniques to study fungal spora (gravity slide method, Tilak air sampler)
8. Calibration of microscope and measurement of fungal spores
9. Sketching of fungal spore by camera lucida technique
10. Detection of organic acids from healthy and infected leaves by circular paper chromatography
11. Detection of Amino acids from healthy and infected leaves by circular paper chromatography
12. Study of pathogens in fruits from local market
13. Study of fungi from locally available seed samples
14. Preparation of sterile media - nutrient agar, potato dextrose agar
15. Preparation of stains and mounting media - cotton blue, lacto phenol and gram stain

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B. Sc. III Year (Practical)
Semester- VI
Paper XXIV (D)
(Bioinformatics) 45L

Credit -1.5

1. Use of operating system and creation of a job from word processor, spread sheet, presentation and data base
2. Creating files, folders and directories
3. Internet browsing and downloading information with special reference to biological literature
4. Creating an e - mail account, sending and receiving e - mail
5. Graphical presentation of data
6. Computer based statistical techniques
7. Frequency table of single discrete variable
8. Computation of mean, median, and mode
9. Computation of mean deviation, standard deviation, coefficient of variation, variance, and standard error
10. Computation of chi- square test, and t - test
11. Students should undertake a visit biotechnology industry, biotechnology research laboratory

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester V
Paper XVII
(Cell Biology and Molecular Biology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester V
Paper XVIII (A)
(Diversity of Angiosperms - I)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester V
Paper XVIII (B)
(Plant Breeding and Seed Technology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 2)
b. Short note (Unit 2)
c. Short note (Unit 2).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester V
Paper XVIII (C)
(Plant Pathology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester V
Paper XVIII (D)
(Biotechnology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 2)
b. Short note (Unit 2)
c. Short note (Unit 2).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester V
Paper XIX
(Cell Biology and Molecular Biology)

Time: 1½ Hour | Max. Marks: 50
Date: _____ | Batch No. _____
Center: _____

Q.1. Prepare a temporary squash / smear of the given material. Identify and describe any two stages (Mitosis / Meiosis). 10

Q.2. Prepare a temporary slide of the given material. Identify and describe giant chromosome (*Chironomous* larvae).

or

Prepare an idiogram of the given karyotype and comment. 10

Q.3.Identify and describe (Electron micrograph) 05

Q.4. Prepare a temporary preparation of given material (Onion/*Tradescantia* leaf) 05

Q.5. Submission:

a) Record book, viva - voce 10

b) Tour report and wool models 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester V
Paper XX (A)
(Diversity of Angiosperms - I)

Time: 1½ Hour | Max. Marks: 50
Date: _____ | Batch No. _____
Center: _____

Q.1. Identify, classify giving reasons and describe the specimen 'A' upto family level. Give floral formula and floral diagram 10

Q.2. Identify, classify giving reasons and describe the specimen 'B' upto family level. Give floral formula and floral diagram 10

Q.3. Identify and describe the specimens C, D, E and F as per the instructions (C-inflorescence, D-Flower, E-Flower and F-Fruit) 10

Q.4. Submission:

a) Record book, viva - voce 10

b) Project report /Tour report and Herbarium 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester V
Paper XX (B)
(Plant Breeding and Seed Technology)

Time: 1½ Hour — Max. Marks: 50
Date: _____ — Batch No. _____
Center: _____

Q.1. Explain hybridization technique in given plant	10
Q.2. Viability test of given seeds	10
Q.3. Preparation of seed certification tag	05
Q.4. Designing of field experiment	05
Q.4. Submission:	
a) Record book, viva - voce	10
b) Project report / Tour report and collection	10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester V
Paper XX (C)
(Plant Pathology)

Time: 1½ Hour — Max. Marks: 50
Date: _____ — Batch No. _____
Center: _____

Q.1. Identify and describe the symptoms and causal organisms of the specimen 'A' Explain on the basis of external and internal characters	10
Q.2. Identify and describe the symptoms and causal organisms of the specimen 'B'. Explain on the basis of external and internal characters	10
Q.3. Identify and describe specimens as per instructions (Four spots)	10
Q.4. Submission:	
a) Record book, viva - voce	10
b) Project report / Tour report and collection	10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester V
Paper XX (D)
(Biotechnology)

Time: 1½ Hour | Max. Marks: 50
Date: _____ | Batch No. _____
Center: _____

Q.1. Identify the experiment and describe principle and procedure
(Meristem Culture / Anther Culture / Protoplast Culture) 10

Q.2. Separation of amino acids by gel electrophoresis

Or

Identify contaminating bacteria and fungi from the given culture 10

Q.3. Identify and describe the given specimens A, B, C, D as per instructions. 10

Q.4. Submission:

a) Record book, viva - voce 10

b) Project report and Tour report 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXI
(Genetics and Biotechnology)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXII(A)
(Diversity of Angiosperms - II)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXII (B)
(Economic Botany)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXII (C)
(Microbiology and Disease Management)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 2)
b. Short note (Unit 2)
c. Short note (Unit 2).

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Faculty of Science
Pattern of Theory Question Paper
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXII (D)
(Bioinformatics)

Time: 1½ Hour Max. Marks: 30

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 1) 10

or

Describe in brief:
a. Short answer type ……(Unit 1)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3).

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXIII
(Genetics and Biotechnology)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Quiz based on genetics and biotechnology.	05
Q.2. Working out laws of inheritance using seed mixture	05
Q.3. Problem based on gene interaction	10
Q.4..Problem based on sex-linked inheritance	10
Q.5. Submission:	
a) Record book ,	10
b) viva - voce	10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXIV (A)
(Diversity of Angiosperms - II)

Time: 1½ Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify, describe and classify giving reasons the specimen upto the family level. Give floral formula and floral diagram	10
Q.2. Identify genus and species of the given plant by using flora	05
Q.3. Determine analytical and synthetic characters between specimens provided	05
Q.4. Identify and describe the specimens A, B, C and D, as per the instructions (A and B – morphology, C- Eco.Imp. D-pollen/trichome/stomata)	10
Q.4. Submission:	
a) Record book, viva - voce	10
b) Project report /Tour report and Herbarium	10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXIV (B)
(Economic Botany)

Time: 1½ Hour — Max. Marks: 50
Date: _____ — Batch No. _____
Center: _____

Q.1. Histochemical tests in given materials 'A' and 'B'
(Starch / Proteins / lipids / cellulose / Lignin) 10
Q.2. Identify and describe the specimens C, D, E, F and G as per the instructions 20
Q.3. Submission:
a) Record book, viva - voce 10
b) Project report / Tour report and collection 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXIV (C)
(Microbiology and disease management)

Time: 1½ Hour — Max. Marks: 50
Date: _____ — Batch No. _____
Center: _____

Q.1. Calibrate the microscope, measure the given spore and sketch with
camera lucida technique 10
Q.2. Detect of organic acids / amino acids from infected and healthy leaves
by circular paper chromatography 10
Q.3. Identify, and describe specimens as per instruction (Four spots) 10
(2 apparatus, 2 pesticide / fungicide)
Q.4. Submission:
a) Record book, viva - voce 10
b) Project report / Tour report and collection 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Practical Examination
B.Sc. III YEAR (BOTANY)
Semester VI
Paper XXIV (D)
(Bioinformatics)

Time: 1½ Hour | Max. Marks: 50
Date: _____ | Batch No. _____
Center: _____

Q.1. Calculate mean, standard deviation, coefficient of variation and standard error of the provided data 10

Q.2. Prepare of a job using - word processor / spread sheet /presentation / database.

or

Represent given data by graphical method 10

Q.3. Computation of chi-square/ t-test 10

Q.4. Submission:

a) Record book, viva - voce 10

b) Project report and Tour report 10

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Recommended books:

1. Principles and Procedures of Plant Protection –S.B. Chattopadhyay.
2. A Hand book of Plant Protection - D. Seshagiri Rao.
3. Chemistry of Insecticides and Fungicides – U.S. Sreeramulu.
4. Plant Protection - Mukundan
5. Systemic Fungicide - S.C. Was
6. Fungicides by- Nene & Thapliyal.
7. Fungi and Plant diseases –B.B. Mundkur.
8. Text book of Modern Plant Pathology - K.S. Bilgrami and H.C. Dube.
9. Plant diseases - R.S. Singh
10. Essentials of Plant Pathology – V.N. Pathak.
11. Plant Pathology –R.S. Mehrotra.
12. Introduction to principle of Plant Pathology- R.S. Singh.
13. Plant Pathology – Agrios.
14. Principles of Plant breeding – H.K. Choudhary.
15. Weed Science – Thakur.
16. Modern Weed Science – O.F. Gupta & P.S. Lamba.
17. Principles of Weed Science - V.S.Rao.
18. Manual of Weed Science – N.C. Joshi.
19. Elements of Economic entomology– Vasantraj Devid and T. Kumar swami.
20. Agricultural Pests of India and South East Asia – A.S. Atwal.
21. General and applied Entomology – K.E. Nayar, B. V. David
22. Crop protection recommendations published by Department of AgricultureM.S.Pune
23. Plant protection recommendations for Horticulture crops-Directorate of Horticulture M. S. Pune –411005
24. Plant diseases in India- G. Rangaswami.
25. Diseases of cereals and millets – T.S. Ramkrishna.
26. Principles of Plant disease control- S.A. J. Tarr,1971.
27. Scientific principles of crop protection – Mortin, Hubert & David Woodcock – Edward Ashold USA.
28. Entomogrow nematodes- Ficheer G. O. Jr.
29. Applied plant Biotechnology – Rao, Dr. S. Ignacimlie, Tak Maegrere.
30. Advances in Mycology & Plant Pathology – R. Chaudhar
31. Text book of Fungi O.P. Sharma – Tata McGraw
32. Elements of Economic Entomology-David & Kumar Swami.
33. Text book of toxicology – Shrivastava.
34. Toxicology of Insecticides – Matsmura
35. Plant orgin insecticides.
36. Recent Advances in Host Plant Resistance –S. S. Dhahiliwa
37. Introduction to In Pest management – G.S. Ahaliwal.
38. Blod, H.C., Aloxopoulos, G. J. and Delevoryas, T. 1980. Morphology Plant and Fungi (4th Edition) Harper and Foul Co., New York.
39. Clifton, A. 1958 Introduction to the Bacteria. McGraw Hill Co., New York.
40. Dube, H. C. 1990. An Introduction to Fungi Vikas Publishing House Pvt. Ltd., Delhi.
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10. Sporne, K. R. 1991. The Moropology of Gymmosperms. B. I. PublicationsPvt., Bombay, Calcutta, Delhi.
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14. Foster, A. S. and Gifford, A.E.M. jr. 1967. Comparative Morphology of Vascular Plants Vakils, Peffer & Simons Pvt., Ltd.
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18. Raghvan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press N. Y.
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20. Albajes, R., Gullino, M.L. van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and Disease Management in Greenhouse Crops, Kluwer Academic Publishers.
21. Bridge. P. et.al 1998. Molecular Variability of Fungal Pathogens. CAB International UK.
22. Bridge. P. et. al. 1999. Application of PCR in Mycology CAB International,UK.
23. Bridge. P. Moore, D.R. and Scott, P.R. 1998. Informational Technology, Plant Pathology and Biodiversity CAB International. UK.
24. Persley, G.J. 1996. Biotechnology and Integrated Pest Management CABInternational, UK.
25. Skerritt, J.H. and Apples, R. 1995. New Diagositic in Crop Sciences. CABInternational, UK.
26. Davis, P.H. and Haywood, V.H. 1963. Principles of Angiosperm Taxonomy.Oliver and Royd, London.
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31. Radford. A.E. 1986. Fundamentals of Plant Systematics Harper and Row,New York..
33. Singh. G. 1999. Plant Systematics: Theory and practice Oxford & IBH Pvt.,Ltd. New Delhi.
34. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge UniversityPress, Cambridge London.
35. Stace. C.A. 1989. Plant Tasonomy and Biosystematics. 2nd ed. Edward

Arnold, London.
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38. Ambasht. R.S. 1988.0 A Text Book of Plant Ecology Students FriendsCo. Varanasi.
39. Botkin, D.B. and Keller, E.A. 2000. Environmental Plane (2nd edition). JohnWiley & Sons Inc. New York.
40. Chapman. J.L. and Reiss. M.J. 1995. Ecology: Principles and ApplicationsCambridge University Press.
41. Cunningham.W.P. and Saifo S.W. 1997. Environmental Science: A GlobalConcern WCB. McGraw Hill.
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103. Nayar 1996 R.S. 600 T.E.F. a R.I., Patoce Chawala.
104. Plant Protection – P.R. Mehta and Verma.
105. Microbiology – Peicar and Reid.
106. Microbiology life – W.R. Sustrom.
107. Morphology of vascular Plant (lower groups) – A. J. Eames.
108. Introduction pteridophtya – A Rashid.
109. Morphology of Gymnosperms – J. M. Coulter and C. J. Chamberlain.
110. Gymnosperms – Structure & Evolution – C. J. Chamberlain.
111. Press – P. Macheshwari and V. Vasid.
112. Morphology of Gymnosperms – K. R. Sporne.
113. An Introduction to Palaeobotany – C. A. Arnold.
114. Studies in Palaeobotany – H. N. Andrews.
115. Essentials of Palaeobotany – A. C. Shukla and S. P. Mishra.
116. The flora I, II & II – T. Cooke.
117. Taxonomy of the Angiosperms – A. J. Eames.
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