Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Ph.D. (Botany) Entrance Test

Section A Research Methodology (Revised in 2020)

Index

Section - A
Research Methodology

UNIT- I:

1. Introduction of Research: Meaning of Research, its importance, aims and objectives, Identification and criteria of selecting a Research Problem (Hypothesis), literature collection, Research Plan and its components, Methodology (Experimental design / Field data collection). Data presentation and interpretation. Drawing conclusions.
2. Scientific paper writing – Manuscript preparation and presentation.
3. Research Journals, Impact Factor and paper citation index.
4. Major Research Institutes related to Plant Sciences in India. A brief idea about Government Research and funding agencies, as DST, DBT, ICAR, ICMR, CSIR, UGC, CST, etc.
5. IPR and Patenting.

UNIT-II:

6. Statistical Methods: Standard deviation, Standard error, Co-efficient of variation, Null Hypothesis, level of significance, Chi-square Test, 't'-Test and 'F'-Test, Analysis of Variance for one-way and two-way classified data.
7. Principles of Microscopy (Light microscope, phase contrast, Electron Microscope (SEM & TEM) and Fluorescence microscope).
8. Biochemical techniques- Principles and methodology of colorimetry, spectrophotometry, pH meter, centrifugation, basic principles underlying different types of centrifuges. Chromatography – partition, thin layer, adsorbtion, sephadex, ion exchange, gas liquid chromatography, HPLC.

UNIT- III:

9. Plant Micro technique – Fixatives and staining (single and double). Fixation for histological and histochemical study. Microtomy.
10. Histochemical methods in Pharmacognosy and Forensic Botany. Organoleptic evaluation of market drugs.
11. Preparation of Cytological slides for study of Mitosis and Meiosis
12. Field and Herbarium techniques.

UNIT- IV:

13. Culture of Algae: Media and isolation of pure cultures.
14. Culture and preservation of Fungi.
15. Plant tissue culture methods. Genetic transformation methods (Agrobacterium-mediated and microprojectile / Biolistic methods).
16. Soxhlet extraction, Column chromatography, TLC, High pressure liquid Chromatography (HPLC), Electrophoresis and ELISA.
17. Principles of Fluorescence, UV, Visible, NMR and Atomic Absorption Spectroscopy and Autoradiography.
18. Basic concepts of Recombinant DNA technology. Gene cloning, DNA fingerprinting technique, Polymerase Chain Reaction and Southern blotting.

UNIT – V.

19. Ethical and Legal issues of Research: Authentication of specimens, Legal permissions for collection of biological material from Local Biodiversity committees, Forest Department, State Biodiversity Board and National Biodiversity Authority.
20. Computer applications: MS Office- Word, Power point Presentation, Excel, Popular Image Formats. Connecting to the Internet, Browsing the Web, Searching for Information, literature and research papers, Downloading, Sending and Receiving Email
21. Photography: Principles and methods of digital photography, photomicrography and image analysis.

Books Recommended (SECTION – A)

1. Arora, J.R.. Madhan Mohan, T., Rajendran, G.J., Kannan, S. And Nambiseshan, S. 1993. Research Profile of Biotechnology Activities in India-A Directory. PID, New Delhi.
2. Banerjee, P.B. 2014. Introduction to Biostatistics. S.Chand & Company Pvt. Ltd., New Delhi, India.
3. Bhattacharya, D.K. 2013. Research Methodology, Excel Books, New Delhi. 5
4. Chandel, S.R.S. 1999. A Handbook of Agricultural Statistics. Acha Prakashan Mandir, Kanpur, India
5. Dhopte, A.M. and Livera-M, M. 1989. Useful Techniques for Plant Scientists. Publication of Forum for Plant Physiologist, R.D.G. College, Hostel-1, Akola-444001(M.S.), India.
6. Freeze, J.T. 2000. Sams' Teach yourself: Computer Basics. Macmillan Computer Pub, USA with Techmedia Pub, New Delhi.
7. Gupta, V. 2014. Rapidex Computer Course. Pustak Mahal, Delhi.
8. Harborne J.B. 1998. Phytochemical Methods - A Guide To Modern Technique of Plant Analysis, 3rd edn, Champan & Hall, UK.
9. Heldt, Hans-Walter. 2005. Plant Biochemistry. Academic Press- an Imprint of Elsevier, New Delhi, India.
10. Jain S. K. and R. R. Rao. 1977. Handbook of Field and Herbarium Techniques. Today and Tommorrows Printers and Publishers, New Delhi.
11. Kothari, C.R. and Garg, G. 2014. Research Methodology: Methods and Techniques. New Age International Publishers, New Delhi, India.
12. Kumar, R. 2012. Research Methodology: A Step-By-Step Guide for Beginners. SAGE Pub. India Pvt. Ltd., New Delhi.
13. Panse, V.G. and Sukhatme, P.V.1985. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India.
14. Singh, V.P. and Purohit, S. 2003. Research Methodology in Plant Sciences. Scientific Publishers (India), Jodhpur.
15. Snell, N. 1998. Sams' Teach yourself: The Internet Starter Kit. Macmillan Computer Pub, USA with Techmedia Pub, New Delhi.
16. Sundararaj, P. And Siddu, A. 1995. Qualitative Tests and Quantitative Procedures in Biochemistry. Wheeler & Co. Ltd., New delhi, India.
17. Swain T. 1963. Chemical Plant Taxonomy, Academic Press London
18. Wilson K and John Walker, 1999. Principles and Techniques of Practical Biochemistry, Cambridge University Press.

Botany Syllabus of Paper II
(Revised 2020)

Sr. No.	Name of The Unit	Detailing
01	**Cell Biology & Molecular Biology, Cytology and Genetics**	1. **Cell Biology:** Organization of plant cell and chloroplast, mitochondria, Golgi complex, Nucleus, Ribosomes, Endoplasmic Reticulum, Cell wall, Cell membrane, vacuoles, cytoskeleton, The structure and role of RNA,Totipotency, differentiation and cell death, cell cycle, apoptosis, Cell signalling. 2. **Molecular Biology:** Chromosome organization, DNA replication and repair, Chromatin organization, protein synthesis, transcriptional and translational regulation,Protein targeting, Computer assisted chromosome analysis. 3. **Genetics and Plant Breeding:** Mendelian genetics, concept of gene, Linkage and recombination, genetic mapping, extra chromosomal inheritance, chromosome banding, Chromosomal abberations, Mutation, FISH and GISH , Microbial genetics, phage genetics, linkage and crossing over, recombination, homologous and non-homologous linkage maps, 3 point test cross, tetrad analysis in yeast and Neurospora. Selection-Mass and Pure line selection, hybridisation-Backcross and Test cross, Heterosis breeding, Mutation breeding, role of polyploidy in plant breeding, genetically engineered plants.
02	**Biology and Diversity of Algae, Fungi and Microbes, Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany**	1. **Algae:** Introduction of phycology, Algae in diversified habitats, Systems of classification of algae, General account of thallus organization, reproduction and life history of algae, General account, cell structure and method of reproduction in Cyanophyta; Chlorophyta; Xanthophyta; Bacillariopyta; Phaeophyta and Rhodophyta, Algal blooms, Role of Algae in human welfare, biofertilizer. 2. **Fungi:** General Characters, Classification, Economic importance of fungi, Fungi as plant pathogen, General account of different groups and type study of fungi as pathogen - Mastigomycotina; Ascomycotina, Basidiomycotina and Deuteromycotina. 3. **Bacteria:** General characters, ultrastructure, classification, Koch's postulates, archaebacteria and eubacteria. Role of agrobacterium in GM crops. Citus canker, Angular leaf spot of cotton. 4. **Phytoplasma:** General Account, ultrastructure and economic importance of Grassy shoot of sugarcane. Little leaf of brinjal.

		5. **Viruses:** General account, ultrastructure and economic importance of viruses. TMV, Papaya leaf curl. 6. **Bryophytes:** Systems of classification, distribution,. Habitat, Economic importance, external and internal morphology, reproduction, gametophytes and sporophytes, phylogeny and interrelationships of the orders: Sphaerocarpales, Takakiales, Marchantiales and Jungermanniales, Anthocerotales, Sphagnales, Andreales and Bryales. 7. **Pteridophyta:** Classification, Origin and evolution, Phylogenetic relationship with Bryophyta, Morphology, anatomy, phylogeny and interrelationships of the orders Psilotales, Psilophytales, Lycopodiales, Selaginellales, Isoetales, Equisetales and Filicales. Sporophyte and gametophyte in Pteridophytes, Stelar organization and evolution, Origin of leaf and Telome concept, Sporocarp, Heterospory and seed habit. 8. **Gymnosperms:** Introduction, Classification and distribution of Gymnosperms, Morphology, anatomy, reproduction, phylogeny of the orders Pteridospermales, Bennettitales, Cycadales, Ginkgoales, Coniferales, Taxales and Gnetales, Economic importance of gymnosperms. 9. **Palaeobotany:** Introduction, Contributions of Prof. Birbal Sahani, Geological time scale, Fossils and fossilization, Continental drift/ plate tectonics.
03	**Taxonomy of Angiosperms, Plant Development & Reproduction, Bioprospecting and Plant Resource Utilization**	1. **Angiosperms:** Aims, objectives and scope of taxonomy, Nomenclature and classification. Taxonomic literature, Evolutionary trends and variations, IUCN, phylogenetic classifications, APG system of classification, species concepts, speciation, Biosystematics, biosystematics categories. 2. **Plant Development:** Vegetative and reproductive development in plants, organization of plant structures, Regulation of plant development by intrinsic and extrinsic factors(light, Hormones). Molecular aspects of development. 3. **Reproduction:** Flower, Pollination, Male and Female Gametophyte, Seed Development and Fruit growth. 4. **Bioprospecting and Plant Resource Utilization:** Ethnobotany, types of Bioprospecting, Phytochemicals used in aroma, flavour and medicines, plant resources and natural products, Exploration of

		lower and higher plant forstandardization of herbal medicines as per US-FDA.
04	**Anatomy, Plant Physiology and Metabolism & Ecology and Conservation**	1. **Anatomy:** Plant as Unique Organisms, History and tools of Plant Anotomy, Cellular Plant Anatomy, Vascular Tissues, Primary and Secondary , vegetative growth, Flowering and Reproduction. 2. **Plant Physiology and Metabolism :** Water relations and membrane transport, photosynthesis and respiration, nitrogen metabolism, Lipid Metabolism, hormones, Stress physiology and tolerance mechanisms, strategies used for development of stress resistant / tolerant plants. 3. **Ecology and Conservation:**Ecosystem- structure, types and functions, Ecological succession, habitat, biomes, Biomes, population ecology, plant interactions, phytogeography, Biodiversity, endemism, RET species, IUCN categories, Ecological modelling Niche, evolution and co-evolution, Diversity types.Strategies of Conservation. Biological Diversity Act 2002.
05	**Biotechnology, Genetic Engineering and Bioinformatics**	1. **Biotechnology, Engineering and Bioinformatics:** Plant tissue culture techniques, Micropropagation, cell, tissue andorgan culture, Elicitation and secondary metabolites production. Enzymes in genetic engineering, cloning vectors, *Agrobacterium* mediated gene transfer, characterization of transformants, Gene libraries, DNA sequencing, Introduction to Genomics and Proteomics, PCR and RTPCR techniques. 2. **Bioinformatics Databases**: Primary sequence databases (GenBank-NCBI, the nucleotide sequence database-EMBL, DNA sequence databank of Japan-DDBJ; Protein sequence and structure databases (PDB, SWISS-PROT and TrEMBL); Derived (Secondary) Databases of Sequences and Structure: Prosite, PRODOM, PRINTS, Pfam, BLOCK, SSOP, and CATH. Enzyme Database, Biodiversity Database.

Unit	Botany Reference Books
UNIT-I **Cell Biology & Molecular Biology, Cytology and Genetics**	1. Lewin, B. (2000). Genes VII. Oxford University Press, New York, USA. 2. Lewis, R. (1997). Human Genetics: Concepts and applications (2nd ed), WCB, McGraw Hill, USA. 3. Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge. 4. Lewin, B. (2000). Genes VII. Oxford University Press, New York, USA. 5. Lewis, R. (1997). Human Genetics: Concepts and applications (2nd ed), WCB, McGraw Hill, USA. 6. Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge. 7. **Priyadarshan,** P.M. (2019). Plant Breeding: Classical to Modern. Springer Singapore
UNIT-II **Biology and Diversity of Algae, Fungi and Microbes, Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany**	8. Chapman V.J. and Chapman, D.J. (1983) The Algae, The MacMillan Press Ltd., London. 9. Desikachary T.V. (1959) Cyanophyta, 1CAR, New Delhi. 10. Fritsch F.E. (1961) The Structure and Reproduction of the Algae, Vol. I & H, Cambridge University Press, London. 11. Kumar, H.D. (1988) Introductory Phycology, Affiliated East-West Press Pvt. Ltd., New Delhi. 12. Sinha, U. and Sheela Shrivastava (1985) An Introduction to Bacteria, Vikas Publishing House Pvt. Ltd., New Delhi. 13. Burgey's Manual of Systematic Bacteriology, Vol. 1-4(1986-1989) Williams & Wilkins, Baltimore. 14. Verma, J.P. (1992) The Bacteria, Malhotra Publishing House, New Delhi, 15. Salle, A.J. (1974) Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Co. Ltd., New Delhi. 16. Alexopoulous C.J., Mims, C.W.and Blakwel, M. (1996) - Introductory Mycology, John Wiley & Sons Inc. 17. Dube H.C. (1994) - An Introduction to Fungi, Vikas Publishing House, New Delhi. 18. Mukadam D.S. (1997) 'The Illustrated Kingdom of Fungi', Aksharganga Publication, Aurangabad. 19. Agashe, S. N. (1995) Paleobotany, Oxford & IBH, New Delhi Bir, S. S. (2005) Pteridophytes their Morphology, Cytology, Taxonomy and Phylogeny. Today & Tomorrow's Printers & Publisher.

	20. Biswas, C. and Johri, B.M. (2004) The Gymnosperms, Narosa Publishing House, New Delhi 21. Coulter J. M. and Chamberlain, C.J. (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad 22. Eames, A. J. (1974) Morphology of Vascular Plants-lower groups, Tata Me Graw-Hill Publishing Co. New Delhi. 23. Parihar, N. S. (1991) Bryophytes, Central Book Dept., Allahabad. 24. Parihar, N. S. (1976) The biology and morphology of the pteridophyta, Central Book Depot, Allahabad. 25. Prem Puri (1973). Bryophytes: A Broad Perspective. Atma Ram and Sons, New Delhi. 26. Rashid, A. (1976) An introduction to Pteridophyta, Vikas Publishing House Ltd., New Delhi. 27. Sambamurty, A. V. S. S. (2005) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, Today & Tomorrow's Printers and Publishers 28. Ramkrishna, P. S. (2001) Ecology and Sustainable Development. National Book Trust, New Delhi. 29. Nikias, K. J. (1981). Paleobotany, Paleoecology and Evolution. Praeger Publishers, USA 30. Shukla, A. C. and Mishra, S. P. (1982). Essentials of Paleobotany. 2nd ed. Vikas Publishing House Pvt. Ltd., New Delhi. 31. Hale, M. E. Jr. (1983). Biology of Lichens. Edward Arnold, Maryland
UNIT-III **Taxonomy of Angiosperms, Plant Development & Reproduction, Bioprospecting and Plant Resource Utilization**	32. Davis, P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Krieger Pub. Co. New York. 33. Grant, W.F. (1984). Plant Biosystematics, Academic Press, London. 34. Harrison, H.J. (1971). New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd.,London. 35. Heywood, V.H. and Moore, D.M. (1984).Current Concepts in Plant Taxonomy, Academic Press, London. 36. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper & Raw Publications, USA. 37. Hopkins WG. (2006). The Green World: Plant Development, Chelsea House Publication 38. Howell SH. (1998) Molecular Genetics of Plant Development, Cambridge University Press. 39. Sharma, P. D. (2001) Ecology and Environment, Rastogi Publications. Meerut.

	40. Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York. 41. Naik, V. N. (2000). Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Limited, New Delhi. 42. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science MonographNo.7. 43. Baker, H.G. (1978), Plants and civilization. Ill Ed. (A. Wadsworth, Belmount). 44. Bole, P.V. and Vaghani, Y. (1986). Field guide to common Indian trees, Oxford University Press, Mumbai. 45. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow. 46. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd., 47. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi. 48. Kocchar, S.L. (1998). Economic Botany of the tropics, 2nd ed. MacMillan India Ltd., 49. Sharma, P. P. and Singh, N.P. (2001). Ethnobotany of Dadra Nagar Haveli and Daman (UT), Publ. BSI, Kolkata.
UNIT-IV **Plant Anatomy, Plant Physiology and Metabolism & Ecology and Conservation**	50. Richard Crang, Sheila Lyons-Sobaski and Robert Wise (2018). Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing, Switzerland AG. 51. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom. 52. Esau, K, 1965. "Plant Anatomy" (2nd ed; 7th reprint 1991), Wiley Eastern, New Delhi. 53. Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK. 54. Salisbury, F.N. and Ross, C.W. Plant Physiology, 3rd Edition (2006): CBS Publishers and Distributors, New Delhi. 55. Lehninger, A.L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi. 3. 56. Bidwell, R.G.S. (1974) Plant physiology, Mac Millan Publishers Co.,New York. 57. Devlin, R.M. and Hostan, F.H., Plant physiology, CBS Publishers and Distributors, New Delhi.
UNIT-V	58. David Clark and Nanette Pazdernik (2015). Biotechnology. 2nd ed. Publ.Academic Press.

Biotechnology, Genetic Engineering and Bioinformatics	59. Gupta, V., Sengupta, M., Prakash, J., Tripathy, B.C. (2017). Basic and Applied Aspects of Biotechnology Publ. Springer Singapore. 60. Henry, R.J. Practical application of plant molecular Biology, Champman and Hall. 61. Kalyan kumar De (2008). Introduction to Plant Tissue culture, New Central Book Agency. 62. Bhojwani, S.S. M.K. Razdan (1996). Plant Tissue Culture. Publisher, Elsevier Science 63. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology. 64. 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. 65. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York. 66. Ramsden**,** Jeremy (2015). Bioinformatics An Introduction. Publ. Springer-Verlag London. 67. Supratim Choudhuri (2014). Bioinformatics for Beginners. 1st ed. Publ.Academic Press. 68. Godbey, W.T. (2014). An Introduction to Biotechnology.Publ. Academic Press 69. Chawla H. S. (2017). Introduction to Plant Biotechnology 3rd ed. Publ. Oxford & Ibh Publishing

Name & Signatures of Syllabus Committee:

Dr. Ashok M. Chavan	**Dr. Vikram Khilare**	**Dr. P.P. Sharma**
Professor	**Professor**	**Principal**
(Chairman)	**(Member)**	**(Member)**

Date:
Place: Aurangabad