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Item No. \_\_\_\_\_

**UNIVERSITY OF MUMBAI**



**Syllabus  
for the  
PET Examination  
In  
Botany**

(With effect from March, 2020 onwards)

**UNIVERSITY OF MUMBAI****Syllabus for Approval**

Sr. No.	Heading	Particulars
1	Title of the Course	PET IN BOTANY
2	Eligibility for Admission	MSc in Botany
3	Passing Marks	50
4	Ordinances / Regulations ( if any)	
5	No. of Years / Semesters	
6	Level	P.G. / U.G./ Diploma / Certificate ( Strike out which is not applicable)
7	Pattern	Yearly / Semester ( Strike out which is not applicable)
8	Status	New / Revised ( Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year <sup>MARCH</sup> 2020- <del>21</del>

Date:

Signature :

Name of BOS Chairperson / Dean :

Forwarded through  
  
 Dr. Anuradha Hajirunde  
 07/03/2020

## PET SYLLABUS FOR BOTANY STUDENTS 2020 ONWARDS

### PAPER I Research Methodology

1. **Foundation of Research:** Meaning, Objectives, Motivation, Utility, Characteristics and Types. Characteristics of scientific methods - understanding the language of research - Concept, Construct, definition, Variable. Scientific Research Process. Steps of research, methods of research, research ethics.
2. **Problem Identification & Formulation:** definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem. Literature survey: primary and secondary; web sources; critical literature review. Research Question - Investigation Question - Hypothesis testing - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis
3. **Research Design:** Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables. Biased and unbiased research design
4. **Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches. **Biological data:** Types of data - Qualitative data, Quantitative data
5. **Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.
6. **Measurement:** Concept of measurement - what is measured? Problem in measurement in research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.
7. **Sampling, data collection and analysis:** Concept of Statistical population, Sample, Sampling Frame, Sampling Error, Sample size, Non Response. Characteristics of a good sample, sample distribution, Probability and Probability distributions. Determining size of the sample - Practical considerations in sampling and sample size. Data analysis - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test including testing hypothesis of association including Chi test, correlation and regression analysis, t-test, z-test, ANOVA- one way and two way.
8. **Interpretation of Data and Paper Writing:** Graphical interpretation of data, Layout of a Research Paper, Journals, Ethical issues related to publishing, Plagiarism and Self- Plagiarism.
9. **IPR :** Types, Copyrights in Scientific work, Patents in scientific research, Writing a patent specification, patent filing and grant, infringement. Gene patenting, Farmer's rights, Plant Breeder's rights, Traditional knowledge and protection.

10. **Reasoning and Mental ability:** Analogy, Logical reasoning and aptitude, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test, Representation through Venn- diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions, Statement & actions.

**Reference books:**

- 1) Garg, B. L. Karadia R. Agrawal, F. and Agrawal U. K., 2002. An Introduction to Research Methodology, RBSA Publishers
- 2) Kothari C. R., 1990. Research Methodology: Methods and Techniques New Age International 418p.
- 3) Sinha S. C. and Dhiman A. K., 2002. Research Methodology Ess Publications 2 Columes.
- 4) Trochim W. M. K., 2005. Research Methods: The Concise Knowledge Base Atomic Dog Publishing. 270P
- 5) Wadehra B. L., 2000. Law Relating to Patents, Trade Marks, Copyright Design and Geographical Indications, Universal Law Publishing
- 6) Research Methodology: An Introduction- Stuart Melville and Wayne
- 7) Practical Research Methodology- Catherine Dawson
- 8) Research Methods for Science Michael P Marder
- 9) Research Methodology: Principle, Methods and Practices- Joshua O. Miluwi and Hina Rashid
- 10) Research Methodology: A Step By Step Guide for beginners- Ranjeet Kumar
- 11) How to Write and publish a Research Paper- Seventh Edition- Robert Day And Barbara Gastle
- 12) Introduction to Biostatistics and Research Methods- P S S Sunder Rao
- 13) Research Methodology and Scientific Writings- C George Thomas

## **PAPER II CORE SUBJECT: BOTANY**

### **1. Instrumentation and Techniques:**

Plant microtechnique – fixation, dehydration, microtomy and staining; Centrifugation methods; pH and buffers, Flow cytometry; Microscopy: light, Phase contrast, Fluorescence and confocal microscopy, SEM and TEM; Chromatographic techniques – Paper, column, TLC, HPTLC, HPLC, GCMS; Immunological and Electrophoretic techniques; Spectroscopy: Light, UV-Vis, IR, AAS, ICP-AES, NMR, MALDI -TOF; Radioactive tracer techniques.

- ### **2. Biostatistics and Bioinformatics:** Experimental Design – Completely Randomized Block and Factorial Experimental Design. Analysis of variance, Populations and samples, Graphical representation of data, frequency distribution, central tendency and dispersion, Introduction to databases and

retrieving information from databases, Molecular tools in protein and nucleotide sequence analysis.

3. **Plant Diversity:** Prokaryotes and viruses, algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. General characters, classification and interrelationships and affinities between preceding and following groups as mentioned in the MSc part 1 Botany syllabus of Mumbai University . Paleobotany.
4. **Biosystematics:** Aims, objectives and scope of taxonomy, Nomenclature and classification. Taxonomic literature, Evolutionary trends and variations, ICN, phylogenetic classifications, APG system of classification, species concepts, speciation, Biosystematics, biosystematic categories.
5. **Developmental Biology :** Shoot Development: Organization of shoot apical meristem; regulation of cell fate in meristem; tissue differentiation in the shoot. Root Development: Organization of root apical meristem; vascular tissue differentiation; lateral root hairs; root microbe interactions. Leaf growth and differentiation: Determination; phyllotaxy; control of leaf form; differentiation of epidermis (stomata & trichomes) and mesophyll. Embryology: Microsporogenesis, megasporogenesis, fertilization, embryo development, seed characteristics, Palynology: structure of pollen grains, types, wall ornamentation, pollen pistil interaction, forensic application.
6. **Cell, Molecular Biology and Biochemistry:** Structures of Carbohydrates, Lipids, Proteins, Nucleic acid, Enzymes, Enzyme kinetics; Metabolism of carbohydrates, Lipids, Proteins, .Chromosome organization, DNA replication and repair, Chromatin organization, protein synthesis, post-translational modifications of peptides, transcriptional and translational regulation, Protein targeting. Organization of plant cell and chloroplast, mitochondria, Golgi complex, Nucleus, Ribosomes, ER, Cell wall, Cell membrane, vacuoles, cytoskeleton, Totipotency differentiation and cell death, cell cycle and its regulation, apoptosis, signal transduction in cells.

**5 Ecological principles:** Ecology: Ecosystem- structure, types and functions, Ecological succession, habitat, pH and buffers, biogeochemical cycles, Biomes, population ecology, plant interactions, phytogeography, endemism, RET species, IUCN categories, endemism, Ecological modelling Niche, evolution and co-evolution, Diversity types, distribution and global pattern of biodiversity, conservation biology: PAN, *ex-situ* and *in-situ* methods, climate change, strategies to combat greenhouse gases, IPCC, Biopiracy. Pollution types, biomagnification and bioaccumulation, bioremediation, hyperaccumulators.

## 7. **Genetics:**

Mendelian principles : Extensions of Mendelian principles, Gene mapping methods : Linkage maps, tetrad analysis, Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance, Polyploidy –induction and application, Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Mutations : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, Metabolic disorders.

8. **Plant physiology:** Water relations and membrane transport, translocation of solutes, photosynthesis and respiration, lipid metabolism, nitrogen metabolism, plant hormones – Biosynthesis and physiological effects, Photoperiodism, seed dormancy. Stress physiology and tolerance mechanisms, strategies used for development of stress resistant / tolerant plants. Secondary metabolites: Structures and types, extraction methods.

9. **Ethnobotany and Bioprospecting:** Ethnobotany, types of Bioprospecting, Phytochemicals used in aroma, flavour and medicines, plant resources and natural products, Exploration of lower and higher plants for standardization of herbal medicines as per US-FDA

10. **Modern trends:** Restriction enzymes, cDNA libraries, isolating a gene of interest, Southern, Northern and South-Western blotting techniques, DNA sequencing, PCR, DNA barcoding, rDNA technology and applications, PTC and its applications, transgenic plants and applications, nanotechnology: use of plants for synthesis of nanomaterials.

## **REFERENCE MATERIAL:**

As prescribed for the Mumbai University MSc Botany syllabus.