

# *Syllabus for Biology Master's*

## **Section 1: Subject Knowledge**

Please Note: A Total of 40 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Master's Candidate.

### Unit I: Plant Physiology

Water's role in plant metabolism, water transport, and stomatal function. Mineral nutrition and nutrient uptake. Photosynthesis (C3, C4, CAM), respiration, and plant growth regulators. Overview of secondary metabolites and their role in plant defense.

### Unit II: Cell Biology

Structure and function of membranes, cytoskeleton, organelles, and nucleus. Cell division, signaling pathways, metabolism, energy production, intracellular trafficking, and cell communication. Role of the extracellular matrix in tissue organization.

### Unit III: Genetics

Mendelian genetics, complex inheritance, gene interactions, and quantitative traits. Gene structure, DNA replication, transcription, translation, and regulation. Epigenetics, population genetics, genomics, and genetic engineering (e.g., CRISPR).

### Unit IV: Environmental Biology

Organism-environment interactions. Population dynamics, community structure, ecosystem functions, biodiversity conservation, pollution, sustainable resource management, and climate change. biogeochemical cycles, environmental microbiology, ecological modeling, and human impact. Environmental policies, conservation strategies, and emerging technologies.

### Unit V: Biochemistry

Structure, function, and interactions of proteins, nucleic acids, carbohydrates, and lipids. Molecular genetics and post-translational modifications. Techniques: chromatography, electrophoresis, spectroscopy, enzyme activity, protein purification, and molecular cloning.

### Unit VI: Applied Biology

Gene expression, CRISPR, recombinant DNA, and synthetic biology. Environmental applications: bioremediation and sustainable agriculture. Microbial roles in disease and vaccines. Ethical and legal aspects of biotechnology.

### Unit VII: Biostatistics

Importance of statistics in biology and health sciences. Data types and presentation. Introduction to statistical software (R/SPSS). Probability theory, distributions (normal, binomial, Poisson), and Central Limit Theorem. One-way and two-way ANOVA, assumptions, and post-hoc tests.

#### Unit VIII: Developmental Biology

History, key experiments, and basic concepts (differentiation, morphogenesis). Model organisms and early embryonic development. Mechanisms of fertilization, cell fate, and pattern formation. Cell signaling, genetic regulation, and tissue regeneration. Stem cells and regenerative medicine.

#### Unit IX: Microbiology

Microbial structure, classification, physiology, and diversity. Gene expression, mutation, and genetic engineering (CRISPR). Microbial ecology and adaptations. Immune system functions, antigen recognition, and immune responses. Immunopathology, vaccines, and immunological techniques.

#### Unit X: Immunology

Innate and adaptive immunity, Organs and cells involved in immunity, Hematopoiesis, and immune cell lineages, Physical barriers to infection, Pattern recognition receptors, Complement system, Phagocytosis and inflammation, Cytokines and chemokines in innate immunity, Natural killer cells.

### **Section 2: Fundamental Skills**

Please Note: A Total of 24 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Master's Candidate.

Unit I: Data Analysis

Unit II: Math and Statistics

Unit III: Lab Skills

Unit IV: Reading and Writing

### **Section 3: Specific Skill Proficiency**

This section has more than 30 skills. You can select the ones you are proficient in from the enrollment form. You can choose a maximum of 4 skills. Each skill contains 10 questions.