SYLLABUS FOR Ph.D. COURSE WORK

DEPARTMENT OF PLANT MOLECULAR BIOLOGY
FACULTY OF INTERDISCIPLINARY & APPLIED SCIENCES
UNIVERSITY OF DELHI, SOUTH CAMPUS
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The department offers the following three papers for Ph.D. course work. All three papers are also open for students from other departments under FIAS. The Ph.D. students of Department of Plant Molecular Biology can also opt for courses in allied subjects being offered by other departments affiliated to FIAS. A student shall undertake and pass at least three papers in one year (two semesters), of which 'Research Methodology' paper is compulsory. The courses to be taken by students in each semester should be in consultation with the Supervisor and with concurrence of the Departmental Research Committee (DRC).

Details of Papers:
The research methodology paper is based on literature survey, instrumentation, computer application, data search, and presentation and writing skills. The other two courses are aimed at introducing the students to advances in the field of plant molecular biology and plant biotechnology.

S. No.	Code of the Paper	Name of the Paper
1.	PMB I	Research Methodology
2.	PMB II	Advances in Plant Molecular Biology
3.	PMB III	Special Topics in Plant Biotechnology

Evaluation Criteria:
All three papers will have components of end-of-semester examination and continuous evaluation or internal assessment. The criteria for internal assessment shall be decided by the Coordinator and the teachers involved in teaching the respective courses. The maximum marks for each paper are 100 and a student has to score at least 50 marks to pass a paper. The distribution of marks is as follows:

		Maximum Marks (100)	
Code of the Paper	Offered in Semester	End-of-semester Examination	Internal Assessment
PMB I	Semester I (July-Dec)	70	30
PMB II	Semester I (July-Dec)	70	30
PMB III	Semester II (Jan-May)	70	30

PMB I: RESEARCH METHODOLOGY

1. **Instrumentation** -- Basic techniques in Microscopy, Spectroscopy, Spectrometry, Centrifugation, Electrophoresis (gel and chip), Biacore, Gene gun (biolistic), related topics.

2. **Core Techniques of Molecular Biology** -- Cloning methodologies, Expression vectors, PCR and its modifications, Gene expression studies, Bimolecular interaction studies, Next Generation Sequencing (NGS) methodologies, Protein sequencing, related topics.

3. **Literature Survey** -- Reading and interpretation of research papers, Critical analyses of research problems, Research design, Sampling, Patent search, related topics.

4. **Computer Applications** -- Basics of Computer Operating System: basics of UNIX and Linux commands, Using Windows, Directory structures, Command structure (Document preparation, EXCEL, Power Point Presentation), Scientific editing tools, related topics.

5. **Database Search & their Utilities** -- Data mining and analysis, preparation and interpretation.

6. **Introduction to Biostatistics** -- Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis, Cross tabulations, t-test, Chi-square test, correlation, SPSS, p-value, ANOVA (analysis of variance), cluster analysis, related topics.

7. **Presentation Skills** -- Oral and written presentations, Hand-outs and Brochures, Paper and grant writing skills, Thesis writing tutorials, Project work (drafting a research paper or a project work), related topics.

8. **Ethics in Science** -- Copyright, Royalty, Intellectual property rights and Patent laws, Reproduction of published material, Plagiarism, Citation and acknowledgements, Reproducibility and accountability, Conflict of Interest, related topics.

PMB II: ADVANCES IN PLANT MOLECULAR BIOLOGY

1. **Unifying Concepts in Light and Hormone Signal Transduction in Plants** -- Diversity of sensory receptors and their evolutionary significance; Two-component sensor-regulator system; Role of protein turnover in light and hormone signaling; Light- and hormone-regulated gene expression.

2. **Forefronts of Calcium Signal Transduction in Plants** -- Calcium signaling in abiotic and biotic Stress; Calcium as "Hub and Nodal point" in multiple signaling; Development of calcium signaling networks with advanced tools and techniques.

3. **Plant Development** -- Model systems; Developmental differences between animals and plants; Early plant embryogenesis. Patterning and molecular mechanisms of differentiation.

4. **Gene Regulatory Networks Controlling Flower Development** -- ABCDE model of flower development; Floral initiation; Floral meristem specification; Male reproductive development; Female reproductive development.

5. **Bioinformatics** -- Biological Databases- general overview, details of major plant databases (like TAIR, TIGR, InAct etc.); Basics and applications of sequence alignment-basic concept of sequence alignment (global/local and pairwise/multiple), phylogenetic analysis; Analysis of genome data-generation and analysis of whole genome data, concepts of whole genome annotation taking examples of major plant genome (*Arabidopsis*, rice and *Medicago*).

PMB III: SPECIAL TOPICS IN PLANT BIOTECHNOLOGY

1. **Small RNA-mediated Gene Regulation** -- Non-coding RNAs, different kinds of non-coding small RNAs - microRNAs, siRNAs, piRNAs; Sequencing, detection and validation of small RNAs; Mechanism of action of small RNAs; Biological role of small RNAs; Artificial microRNAs (amiRs); siRNAs: designing and delivery for regulating gene expression; Applications of amiR and siRNA technology.

2. **Plant Biotechnology Tools and Techniques and Production of Transgenics for Resistance to Varied Abiotic Stresses** -- Concepts of conventional plant breeding, molecular breeding and transgenic science; birth and growth of transgenic science; National and International trends of the production of transgenic plants; Tools and techniques for production of transgenic plants; Genetic transformation by bombardment, PEG and electroporation-based methods; Agrobacterium-based transformation; Plant promoters; Vector designing; Different abiotic stresses - temperature stress, drought, salinity; Deleterious effect of abiotic stresses on crop yield; Developing transgenic plants for resistance/tolerance to abiotic stresses; Other important application of transgenic science.

3. **Interaction of Plants with Viruses (Basic and Applied Aspects)** -- Organization, functions and dynamics of viral genes; Viral promoters; Methods to study promoters; RNA-interference and viral infections; Viral suppressors and their role in pathogenesis; Virus-induced gene silencing as a tool for functional genomics; Development of vectors for virus-induced gene silencing; Development of transgenic virus resistance in crops.

4. **Regulation of Fruit Ripening for Delay of Ripening and Quality Addition and Role of Plants as Bioreactors for Production of Pharmaceuticals** -- Role of ethylene; Genes manipulated for delayed ripening; Improvement of folate, lycopene and flavor compounds. Strategies for high-level expression, down-stream processing; Humanization of plant expressed products, few success stories.

5. **Molecular Breeding and IPR-related Issues** -- Introduction to molecular markers and their applications; Introduction to marker-assisted breeding (MAB) and molecular-assisted selection (MAS); Introduction to IPR-related issues, trade marks, copy rights, patents, geographical indicators.