DEPARTMENT OF BIOTECHNOLOGY
VISVA-BHARATI, SANTINIKETAN

Syllabus for Ph.D. course work in Biotechnology (w.e.f. the year 2010)

SEMESTER-I
Full Marks: 100 x 3 papers = 300

Paper-I (Full Marks= 100)

(A) Biotechniques for Biotechnology:

Marks = 60 + Internal Assessment=15; Total = 75

1) **Centrifugation techniques**
   Types of centrifuges, types of rotors, differential and density gradient centrifugation
2) **Spectroscopy**
   Ultraviolet-visible absorption spectroscopy, Fluorescence spectrophotometry, Atomic absorption, IR , NMR and MASS spectrophotometry, X-ray crystallography.
3) **Chromatography**
   a) Paper chromatography
   b) Thin layer chromatography
   c) Ion-exchange chromatography
   d) Affinity chromatography
   e) Gel filtration chromatography
   f) Gas chromatography (GC/GLC)
   g) High pressure Liquid Chromatography (HPLC)
4) **Electrophoretic techniques:**
   a) Electrophoresis of Proteins (SDS-PAGE, Native, Two dimentional gels)
   b) Electrophoresis of Nucleic acids.
5) **Radio-Isotope techniques**
   Radio & Mass isotopes, Sample preparation for radioactive counting, autoradiography, metabolic labeling and measurement of radioactivity, safety and handling.
6) **Biophysical techniques**
   Flow cytometry, Immuno-cytochemistry, Microarray technique, MALDI-TOF

7) **General Bioinformatics:**
   i) Major bioinformatics resources: NCBI, EBI, ExPASy
   ii) Open access bibliographic resources and literature databases
   iii) Sequence and structure databases
   iv) Derived databases
   v) Sequence analysis

vi) Scoring matrices
vii) Sequence-based database searches
viii) Pair wise sequence alignments & Multiple sequence alignments
ix) Designing of degenerate primers based on multiple sequence alignment data
x) Taxonomy and phylogeny
xi) Sequence patterns and profiles

(B) Techniques in Computer Applications:

Marks = 20 + Internal Assessment=55; Total = 25

General syllabus in computer science as prepared for all the science subjects

Paper-II (Full Marks= 100)

The candidate has to prepare a review on the theme of his/her proposed research and submit in bound form for evaluation = 50

The candidate has to present his/her proposed research work before a board of evaluators covering the objectives of the research, methodology to be followed, expected findings and possible significance of the research = 50

Marks = 50 + 50 ; Total = 100

Paper-III (Elective) (Full Marks=100)

The candidate has to choose the course work covering one of the Elective paper from the following related to the subject of his/her choice in paper-II.

Marks = 80 + Internal assessment = 20; Total marks per paper = 100

Elective-1: Microbial Technology

Elective-2: Recombinant DNA Technology

Elective-3: Plant-Microbe Interaction

Elective-4: Biotic and Abiotic Stress Response

Elective-1: Microbial Technology

1. Methods in Microbiology: Isolation and culture of microorganisms from soil and water; pure culture techniques, maintenance of culture, axenic and synchronous culture, culture collections.
2. Systematics and Taxonomy of Microorganisms: New approaches to bacterial taxonomy, Bergey's manual, RAPD, ribotyping, ribosomal RNA sequencing, microbial fingerprinting of environmental samples (DGGE).
3. Metabolic diversity among microorganisms: Phtototropy, mixotrophy, organotrophy, syntrophy, anoxygenic photosynthesis, oxygenic photosynthesis.
4. Molecular mechanism of stress adaptation in microorganisms; Temperature, Desiccation, Salinity and Oxidative stress response, UV sunscreen compounds from microbial sources and their application.
5. Bioprocess technology: Bioreactors, batch and continuous culture, photo-bioreactors, race-way ponds, Down stream processing and product isolation.
6. Microalgal technology: Industrial use of *Spirulina, Dunaliella, Haematococcus, Chlorella* and other microalgae for specialized food, neutraceuticals and biofuel.
7. Immunity to microbes: General features, Immunity to extracellular and intracellular bacteria, fungi, viruses, helminthes and protozoans.
8. Vaccines: Passively acquired immunity, active immunization, live attenuated microbial vaccines, killed organisms as vaccines, Epitope-specific synthetic vaccines, Recombinant vector vaccines, DNA vaccines, Adjuvants.

Elective-2: Recombinant DNA Technology

1. Recombinant DNA technology: Original research papers on restriction enzymes, cloning, sequencing, oligonucleotide synthesis, synthetic genes, DNA sequencing, site directed mutagenesis, host and vector engineering, antisense and ribozyme biotechnologies, protein expression, protein engineering, two and three hybrid systems, PCR and its applications, Bioinformatics tools, overview of molecular modeling.
2. Renewable energy: Sources of renewable energy, Biofuel from biomass, Use of Recombinant DNA technology for construction of specialized microbial strains for improved production of biofuels, Biofuel cells.
3. Bioactive compounds of medicinal values from plants: Various methods for the detection of medicinal activities in plants, Techniques for the isolation and characterization of medicinally active materials from plants, Animal experiments for the determination of biological activities of the active materials, Application of Recombinant DNA technology.

Elective-3: Plant-Microbe Interaction

1. **Introduction to Plant Pathology**: Introduction to the study of plant diseases. Life histories of the organisms which cause disease and host reaction to these organisms at the cellular, whole plant, and crop level.
2. **Plant-Microbe Interactions - Molecular and Ecological Aspects:** Plant diseases and symbioses at all levels, from molecular and genetic to ecological and integrative, with particular emphasis on molecular biology.
3. **Plant Disease Resistance-Mechanisms and Breeding:** Role of host resistance in plant disease control, and techniques used for evaluating host resistance and incorporating resistance factors into new crop varieties.
4. **Diseases of Economic Plants:** Symptoms, epidemiology and control of diseases of crop plants.
5. **Ecology, Epidemiology and Control of Plant Diseases:** Ecology of plant pathogens, plant epidemiology, and the theory of disease control including the role of resistance breeding in the management of plant disease.
6. **Plant Nematology:** Isolation, identification, and behavior of plant parasitic nematodes and research methods for their study in laboratory, greenhouse and filed.
7. **A Genomics Perspective on Fungal Pathogenicity and Development:** Review of taxonomic systems used for the identification of major groups of plant pathogenic fungi. Cytology and morphology of plant pathogen fungi and histopathology of host-pathogen relations.
8. **A Genomics Perspective on Bacterial Pathogenicity and Development:** Ecology, epidemiology, and molecular and biochemical bases of interactions between bacteria and their plant hosts.

Elective-4: Biotic and Abiotic Stress Response

1. Plant-Environment interaction System Biology
2. Physiological and Biochemical responses to abiotic and abiotic stress.
3. Introduction to oxidative stress: Oxygen as a toxic gas and rwactive oxygen species.
4. Chemistry of free radicals and related reactive species: thermodynamics and kinetics, chemistry of biologically important radicals.
5. Antioxidant defenses: Enzymatic and small molecules.
6. Consequences of oxidative stress to biological macromolecules: proteins, lipids and DNA; meachnism of their damage, adaptation and repair.
7. Signaling pathway involved in stress responses.
8. Molecular profiling of stress related genetic elements, Genomics and proteomics of biotic and abiotic stress.