DEPARTMENT OF BIOTECHNOLOGY
VISVA-BHARATI, SANTINIKETAN

Syllabus for Ph.D. Course Work in Biotechnology (w.e.f. 2022-2023)

SEMESTER-I

Full Marks = 350

Paper No.	Paper Name		Marks	
I	Group-A	Techniques in Computer Applications	25	100
	Group B	Research Methodology and Research Techniques	75	
II	Elective Papers			
	Elective 1	Infection and cancer		100
	Elective 2	Plant bioactive compounds		
	Elective 3	Genomics of plant stress biology		
	Elective 4	Biology of Ageing		
	Elective 5	Rice Biotechnology		
	Elective 6	Microbial Technology		
III	Review work	Review work report	50	100
		Seminar presentation	50	
IV	Research and Publication ethics		50	

Total = 350

Note:

i) 20% of the total marks in Paper I, II, III and IVare fromInternal Assessments.

Paper-I

Group-A: Techniques in Computer Applications
Group B: Research Methodology and Research Techniques
Full Marks = 100

Group A:Techniques in Computer Applications

Marks Distribution: 20(Final exam) +5 (Internal Assessment)Total =25

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

Group B:Research Methodology and Research Techniques

Marks Distribution: 60(Final exam) + 15 (Internal Assessment) Total =75

Part - I

Research Methodology:Marks: 20(Final exam) + 5(Internal Assessment) = 25

a) Bioethics: Human, Experimental Animal, Plants, Biosafety.
b) Good laboratory practices.
c) Plagiarism – use of URKUND software
d) Problem identification and objective determination.
e) Data handling : Raw data generation from different instruments, software handling for data processing – Excel, Word, Power point, Graphpad Prism, Photoshop, Corel draw, Image-G application of Bio-statistics.
f) Paper writing and communication: Authorship guidelines, Peer review and Publication.
g) Referencing: Style of reference preparation, Use of End note.
h) Patenting: Writing patent, Concept of legal procedures

Part - II

Research Techniques: **Marks:** 40(Final exam) + 10 (Internal Assessment) = 50

1) Chromatography

a) Ion- exchange chromatography
b) Affinity chromatography
c) Gel filtration chromatography
d) Gas chromatography(GC/GLC)
e) High pressure Liquid Chromatography (HPLC)

2) **Electrophoretic techniques:**

a) Electrophoresis of Proteins (SDS-PAGE, Native, Two dimensional gels)
b) Electrophoresis of Nucleic acids.

3) Advanced techniques

Flowcytometry, MALDI-TOF, Next generation sequencing, Real-time PCR, X-ray crystallography, NMR, Cryo-Electron Microscopy.

4) General Bioinformatics:

a) Major bioinformatics resources: NCBI, EBI, ExPASy
b) Open access bibliographic resources and literature databases
c) Sequence and structure databases
d) Derived databases
e) Sequence analysis
f) Scoring matrices
g) Sequence-based database searches
h) Pairwise sequence alignments & Multiple sequence alignments
i) Designing of degenerate primers based on multiple sequence alignment data
j) Taxonomy and phylogeny
k) Sequence patterns and profiles

Paper - II

Elective Papers

Full Marks = 100

The candidate has to choose the course work given below covering one of the Elective papers related to the subject of his/ her choice in Paper – III from the followings.

Marks distribution= 80 (Final exam) + 20 (Internal assessment) = 100

Elective No.	Elective Name	Teacher Concerned
Elective 1	Infection and cancer	TathagataChoudhuri SamiranSaha
Elective 2	Plant bioactive compounds	Amit Roy
Elective 3	Genomics of Plant Stress biology	Jolly Basak
Elective 4	Biology of Aging	Nilanjana Das
Elective 5	Rice Biotechnology	NarottamDey
Elective 6	Microbial Technology	SoumyaSasmal

Elective 1: Infection and Cancer

1. **Types of infection, symptoms, and pathogenesis:** Different types of pathogens and infection - viral, bacterial, fungal, protozoan, helminthic. General symptoms with special reference to Gamma herpes viruses and Kinetoplastids. Disease progression and outcome in Gamma herpes viruses and Kinetoplastids. Infections leading to cancer by different pathogens. Co-infection.

2. **Cell cycle regulation and aberrations:** Cell cycle check points, Control system of cell cycle -Cyclin, CDK and CDKI. Molecular mechanism of cell cycle regulation. Concept of aberrantcell cycle.

3. **Cell death and homeostasis in mammalian system:** Types of cell death in mammals - Apoptosis, Autophagy and Necrosis. Concept of non-classical cell death mechanisms. Maintenance of homeostasis by proliferation, differentiation and programmed cell death and ageing.

4. **Cellular and biochemical effects on infection and neoplasty:** Effects on cell division, change in oxygen consumption, mitochondrial membrane potential, ATP consumption, Reactive oxygen intermediates, Nitricoxide production.

5. **Immunological effects on infection and neoplasty:** Pathogenic antigens and immunogens. Concept of Tumor specific transplantation antigen and Tumor associated transplantation antigen. Inflammation, Hypersensitivity and Anergy. Lymphocyte maturation and activation. Primary and secondary immune response. Immunological memory andImmunodeficiency. Immune effector mechanisms.

6. **Molecular virology and parasitology:** General mechanism of viral infection, replication, maturation and exit. Classification of oncogenic herpes viruses (Special reference to EBV, KSHV, HCV, HIV). Molecular mechanism of transmission and virulence. Host-pathogen interaction in vector-borne and communicable infections.

7. **Vaccines:** Passively acquired immunity, active immunization, live attenuated microbial vaccines, killed organisms as vaccines, Epitope-specific synthetic vaccines, Recombinant vector vaccines, DNA vaccines, Adjuvants.

8. **Therapeutic strategies of infection and cancer:** Radiotherapy, Chemotherapy and Immunotherapy. Radiation and stem cell transplantation. Concept of antiviral, anti-fungal antibiotics and anti - parasitic drugs. Concept of drug resistance. Synthetic and natural products in therapy. Immunological molecules in therapeutics — attenuated antigens, antibodies, modified antibodies, cytokines.

Elective 2: Plant bioactive compounds

1. What are secondary metabolites, Classification of plant secondary metabolites, Chemical nature,biologicalactivitiesofvaluablesecondarymetabolitesfromplantswithexamples.
2. Different methods for the detection of medicinal activities in plants; Use of analytical and preparative thin layer chromatography and HPLC in isolation of antibacterial compound from plant; Role of TLC spraying reagents in identification of bioactive compound; Basic principles of bioautography technique in identification of bioactiveconstituents.
3. Purification of bioactive constituent(s) by using HPLC; Principles of ^{1H}NMR, ^{13C}NMR,IR, Mass spectroscopy, X-ray crystallography for structural characterization of bioactive compounds.
4. Animal experiments for the determination of biological activities of the active materials.

Elective 3: Genomics of plant stress biology

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-Mechanismsand 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 cropplants.
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 plantdisease.
6. **Abiotic factors causing plant stress**: Different abiotic factors including genotoxic factors that causes plantstress.
7. **Genomic techniques to understand plant stress biology**. Different genomic techniques to decipher the mechanism of plant stressbiology.

Elective 4: Biology of Ageing

1. Evaluate concepts and theories to understand the ageing process. General theories of ageing with special reference to free radical theory of aging.
2. Introduction to oxidative stress.It importance in biological systems. Chemistry of biologically important free radicals.
3. Oxygen toxicity and reactive oxygen species in physiological system: types, origins, structures, MOs, and reactivity.
4. Antioxidant defenses: enzymatic and small molecules, why superoxide dismutasesand catalases are important antioxidant defenses. Measurement of their activities.
5. Consequences of oxidative stress to biological macromolecules: proteins, lipids and DNA; mechanism of their damage, their detection methods.
6. Adaptation and repair mechanisms of oxidative stress-mediated modifications of biological macromolecules.
7. Oxidative stress-mediated diseases in humans.
8. Modulation of ageing studies; possible interventions.

Elective 5: Rice biotechnology

1. Origin, Diversity and Domestication of the genus rice with special reference to syntenic relationship with other cereals.
2. Botanical and Ecological attributes of the genus rice with a major emphasis on wild species and rice relatives.
3. Development of rice genetics and its journey to present day rice Genomics, concise description on IRGSP and last ISRFG meetings.
4. Rice Biotechnology- Differentareasanditsdevelopmentforimprovementofyieldandquality, concept of Golden rice, C4 rice, high Iron and Zincrice.
5. The Green Revolution and rice production, necessity for second green revolution, Green revolution to gene revolution.
6. Marker Assisted Breeding and QTL mapping in rice.
7. Development of abiotic and biotic stress tolerant rice.
8. Concept of Super – hybrid rice
9. Major databases associated with rice research (Gramene, Ensemble plants, PMRD, RAPDB,*Oryza*base).
10. Rice biotechnology and its present application in rice culture (Aerobicrice, SRI,AWDmethod)

Elective 6: Microbial Technology

1. Concepts in Microbiology

   a) Brief account of organisation and classification of micro-organisms
   b) Microscopy (brightfield, darkfield, fluorescence)
   c) Staining of Micro-organisms
   d) Growth of Microorganisms, mathematical models of growth kinetics

2. Fermentation Technology

   a) Concept and outlook of the different fermentation process
   b) Basic concepts for selection of reactors
   c) scale up methods
   d) different downstream process

3. Industrial Applications

   a) Primary products of microbial metabolism: Beer, alcohol, Single cell protein, amino acids
   b) Secondary products of microbial metabolism, Antibiotics (penicillin, tetracycline), alkaloids

Paper – III

Review work

Full Marks = 100

Marks Distribution: 50 (Review work report) + 50 (Seminar presentation)Total =100

Review work report:
Thecandidate has to prepare areview on thethemeofhis/herproposedresearchandsubmitin bound form forevaluation.

Seminar presentation:

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.

Paper - IV

Research and Publication ethics

Full Marks = 50

THEORY

• RPE 01 PHILOSOPHY AND ETHICS (3 HRS.)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

• RPE 02: SCIENTIFIC CONDUCT (5 hrs.)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

• RPE 03: PUBLICATION ETHICS (7 hrs.)

1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types.
5. Violation of publication ethics authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

• RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

• RPE 05: PUBLICATION MISCONDUCT (4 hrs.)

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

- **RPE 06: DATABASES AND KRESEARCH METRICS (7 hrs.)**

A. Databases (4 hrs.)
   1. Indexing databases
   2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)
   1. Impact Factor of Journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
   2. Metrics: h-index, g index, i10 index, altmetrics