UNIVERSITY OF KALYANI

FACULTY OF SCIENCE

DEPARTMENT OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY

PhD Coursework Syllabus [As per Amended PhD Regulation 2021]

Paper-7(01-RM/A)	**100**
Paper-7(02-RM/B)	**100**
Paper-7(03-ALC/A)	**100**
Paper-7(04-ALC/B)	**100**

PhD Coursework Syllabus [As per Amended PhD Regulation 2021]

for the Department of Molecular Biology and Biotechnology

Paper-7(01-RM/A) [FM: 100, 4 credits]

The Course-work of the Paper 7(01-RM/A) shall be conducted at Faculty level (controlled centrally). The syllabus shall be incorporated when circulated to the department.

Research Methodology (A) Quantitative Methods, Computer Applications, Research Ethics, Training, Field Work, etc.
Marks Allotted: 60+20+20 (Term End Examn.+ Internal Assessment + Viva-voce Examn.)=100 Credits Allotted: 04

Paper-7(02-RM/B) [FM: 100, 4 credits]

Research Methodology (B) Review of Published research, Documentation/ submission of Reports on Review work and Presentation. *Marks Allotted: 60+20+20 (Report +Presentation + viva-voce)=100 Credits Allotted: 04*

Paper-7(03-ALC/A) [FM: 100, 4 credits]

Advanced level course on subject (A) Subject Specific Components *Marks Allotted: 60+20+20 (Term End Examn. + Internal Assessment + Viva-voce Examn.)=100 Credits Allotted: 04*

Group A: Basics of Bioprocess Technology: [FM = 25]

An introduction to fermentation processes- Range of fermentation process, microbial biomass.
Microbial growth kinetics- Batch culture, continuous culture, industrial applications of continuous culture processes, fed-batch culture.
Isolation, preservation and improvement of industrially important and useful microorganisms.
Industrial fermentation- typical media, media formulation.
Media sterilization, sterilization of fermenter, sterilization of the feed.
Inocula for industrial fermentation
Design of fermenter, basic functions, construction, aeration and agitation, oxygen requirements of industrial fermentation.

Group B: Plant Biotechnology: [FM = 25]

Plant tissue culture techniques, components of culture media, variation in culture and regenerated plants, factors affecting growth & morphogenesis. Cellular totipotency, Somatic embryogenesis

and its molecular aspect. Genetic engineering of Plant: methodology; Developments of stress tolerant plants, plants as bioreactors; edible vaccines.

Group C: Recombinant DNA Technology: [FM = 50]

Gel electrophoresis, Blotting techniques, Sub-cloning, Immunoprecipitation, Yeast two hybrid system, ChIP, DNA sequencing, Whole genome Sequencing, RACE, Quantitative PCR, Site directed mutagenesis, Experimental approaches in understanding gene expression, Heterologous gene Expression.

Paper-7(04-ALC/B) [FM: 100, 4 credits]

Advanced level course on subject (B)*
Transdisciplinary Components *Marks Allotted: 60+20+20 (Term End Examn. +Internal Assessment + Viva-voce Examn.)=100 Credits Allotted: 04*

*(Two transdisciplinary courses shall be chosen from a group of transdisciplinary recognized subjects)

I Advanced cell biology [FM: 50, 2 credits]

1. Internal organization of the cell and cellular dynamics:
   Membrane structure; Intracellular Compartments and Protein Sorting; Intracellular Membrane Traffic; Cytoskeletal dynamics; lysosome remodeling and repair
2. Cells in their social context:
   Cell signaling; cell junction and extracellular matrix; Development of multicellular organism, Cancer- differentiation of tumor microenvironment
3. Cellular homeostasis: Post translational and post transcriptional modifications; The dark proteome: translation from non-canonical open reading frames.
4. Genome evolution

II Regulation of Mammalian Gene Expression [FM: 50, 2 credits]

1. Complexities in the regulation of mammalian gene expression; Chromatin remodelling; the role of super-enhancer, long noncoding RNA, RNA modification and circular RNA in gene expression.

2. Modern techniques to explore the regulation of gene expression: Chromosome Conformation Capture Analysis, RNA-seq and single nucleus RNA-seq. High throughput RNA-protein interaction study: eCLIP and RBNS.

III Microbial Enzyme Technology [FM: 50, 2 credits]

1. Enzymes from different microbial sources.
2. Upstream processes for large scale enzyme production.
3. Concept of solid state fermentation.
4. Downstream processes for recovery of enzymes and enzyme purification methods.
5. Immobilized enzymes: Physical and chemical methods of immobilization, immobilization supports.

IV Biotechnological Tools for Genetic Engineering of Plants [FM: 50, 2 credits]

1. Basic techniques:

Overview of gene-transfer strategies; major plant tissue-culture steps for transgenic plant development; Agrobacterium-mediated transformation; Vector Construction and Genes for Plant Transformation; Promoters for Plant Transformation; Reporter and Selectable Marker Genes; Leaf-disc transformation by *Agrobacterium tumefaciens*; High-capacity binary vectors; Direct DNA transfer to plants; In planta transformation; Chloroplast transformation.

2. Advanced techniques:

RNA interference (RNAi); cisgenesis/intragenesis, trans-grafting, and gene editing techniques: Zinc Finger Nuclease (ZFN) and TALE Nucleases (TALENs); clustered regularly interspaced short palindromic repeats/CRISPR-associated protein 9 (CRISPR/Cas9 system); Removing Marker Genes from Nuclear DNA: using transposable elements, recombinase gene, d-amino acid oxidase gene, betaine aldehyde dehydrogenase; Genetic engineering for male sterility-Barnase-Barstar; Terminator gene technology.