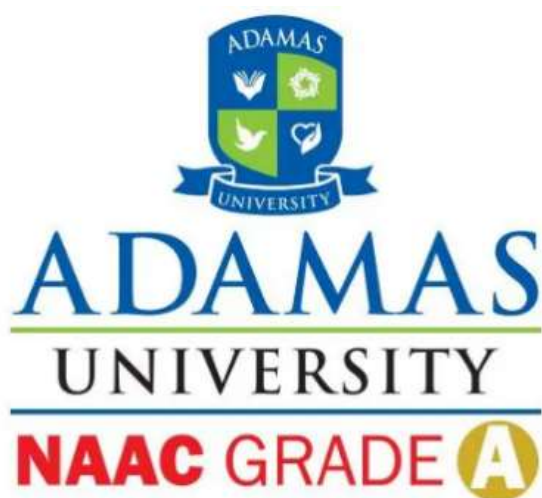




ADAMAS UNIVERSITY

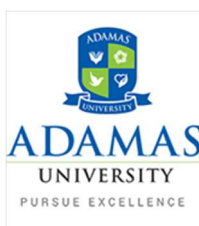
SCHOOL OF LIFE SCIENCE AND BIOTECHNOLOGY

Department of Biological Sciences

Ph.D in Biochemistry

(Program Code: BIC6305)

(2026-27)



ADAMAS UNIVERSITY, KOLKATA

Ph.D in Biochemistry (2026-27)**Course Structure****Total Credit: 14****SEMESTER - I**

Type of the Paper	Paper Code	Theory / Practical	Contact Hour Per Week	L	T	P	Credit
Theory	RES81101	Research Methodology Computer Application	4	4	0	0	4
Theory	RPS81101	Research and Publication Ethics	2	2	0	0	2
Theory	ECS81101	Computer Application	4	4	0	0	4
Theory	BIC31001/ BIC31002/ BIC31003/ BIC31004/ BIC31005	Protein engineering and techniques / Application of Spectroscopic techniques to study biomolecular interactions / Advanced Techniques in Mammalian Cell Culture / Advanced Cancer Biology/ Advanced Techniques in Plant Biochemistry and Biotechnology	4	4	0	0	4
TOTAL			14	14	0	0	14

BIC31001	Protein engineering and techniques	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

Unit 1

Analyse of the protein structure, structure determination methods, X-ray crystallography, NMR, Cryo-electron microscopy, structure and classification of proteins, compare the amino acid sequence and structure of proteins, amino acid sequence to function of proteins correlation, outline the characteristics of individual amino acids and their effect on the solubility, structure and function of proteins.

Unit 2

Factors significant for protein folding processes and stability, early stages in protein folding, Protein folding hierarchy: domains, sub-domains, structure elements, Free energy landscapes, Aggregation / Inclusion bodies, GroEL/S and CCT, DnaK/Hsp70 and co-chaperones, Chaperones and protein synthesis.

Unit 3

Structure dependent and independently design of modified protein, catalytic activity and stereoselectivity, Computational tools for designing and engineering biocatalysts, enzyme engineering, application of kinetic parameter like k_{cat}/K_M to improve substrate specificity,

Unit 4:

Random and site-directed mutations of proteins using genetic methods, construct plasmids for the expression of natural and modified genes, mutagenesis experiments to test protein stability and/or function, primers to introduce mutations by means of PCR, PCR-based mutagenesis experiment, isolation of proteins by biochemical methods, isolated proteins and characterise their purity and stability.

Unit 5:

Use of different proteins and enzymes in industrial and academic purposes such as for structure determination, organic synthesis and drug design; analysis of the purity and stability of proteins; best way to store proteins, development of engineered enzymatic antidotes for therapeutic purposes.

Text Books:

1. Walsh, Gary, **Proteins: biochemistry and biotechnology**, Second edition, Chichester, West Sussex, Wiley Blackwell, 2014
2. Williamson, Michael P., **How proteins work**, New York, Garland Science, c2012

BIC31002	Application of Spectroscopic techniques to study biomolecular interactions	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

Unit 1:

Introduction to spectroscopy, Electro magnetic radiation, Plank equation and $E=hC/\lambda$, Interaction between matter and electromagnetic radiation, Radiation, ionizing and non-ionizing radiation, Atomic and molecular spectra, Atomic orbital and molecular orbital (MO) theory. Stabilizing biomolecular interactions (Van der Waals, electrostatic, hydrogen bonding, and hydrophobic interaction.), dissociation constant K_d .

Unit 2:

UV –Vis spectroscopy, Application and limitation of UV –Vis spectroscopy, Qualitative, quantitative, chemical identification, Limitation, Monochromatic wavelength, scattering, mixed sample, Lambert-beers law, Merits, limitations and Application of UV-Vis Spectroscopy in biological sample analysis

Unit 3:

Principle of Optical Rotatory Dispersion (ORD), Circular Dichroism (CD), circularly polarized light, application of CD in secondary and tertiary structural analysis of nucleic acids and proteins.

Unit 4:

Fourier transform infrared (FTIR), principle, analysis and application of FTIR in characterization of bio-macromolecules.

Unit 5:

Fluorescence spectroscopy, Electronic state, vibrational state, singlet, triplet, Stocks shift, Jablonski diagram, Effect of polarity of the solvent, Fluorescence life time, Fluorescence resonance energy transfer (FRET), photo bleaching, application of fluorescence spectroscopy in biomolecular interaction. Protein-protein, protein-ligand interaction, protein folding and structural change analysis using fluorescence spectroscopy.

Text Book

1. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A.Fremman and Co.
2. Friefelder D, Physical Biochemistry, W. H. Freeman and co.

BIC31003	Advanced Techniques in Mammalian Cell Culture	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

Unit 1:

Equipment's and Materials for animal Cell Culture Technology, Basic Aseptic Techniques, Design of Tissue Culture Laboratory, function and specification of the Equipment's : Laminar Flow Hoods, CO2 incubator, Open and closed cultures, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipment's, Materials, filters. Nutritional Requirements of Cells and growth media, Basal salt solution (BSS), Minimum Essential Medium, Serum dependent defined media, Serum independent defined media – Cell specific media

Unit 2:

Characters of cells : Cells in primary culture, Established Cell lines, Tumor/cancer originated cells, Basic Techniques of mammalian cell culture, Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, Types of cell cultures – a. Monolayer b. Suspension c. Clone culture d. Mass culture-microcarrier culture (monolayer) e. Stem cell culture

Unit 3:

Biology and Characterization of cultured cells, Contamination Testing of Culture, Viability measurement and cytotoxicity, Measurement of growth parameters, Cell cycle analysis and Synchronization of cultures, Cell surgery Methods, Preparation of anucleated cells and polykaryon cells, Preparation of ghost RBCs. Preparation of mini cells, microcells, Surgical manipulation of in vitro fertilization, Cell Fusion Methods, Fusogens : Virus induced' Chemical induced Liposome induced (Preparation of liposomes and use)

Unit 4:

Hybridoma cell preparations and their properties, Use of Hybridoma technology: eg. M AB and other related techniques, Mini cells, micro cells and anucleated cells in fusion and their application. VIII.

Unit 5:

Tissue Engineering, Capillary culture Unit, Techniques for culturing differentiated cells : Reconstituted basement membrane rafts, feeder layers. Applications of Animal Cell Culture, Evaluation of Chemical carcinogenicity, Cell malignancy Testing, Toxicity Testing, Karyotyping and cytogenetic characterization

Text books

- Culture of Animal Cells by R Ian Freshney
- Cell culture technology: Recent advances and future prospects (Euroscicon Meeting Reports Book 1) by Bruserud, Øystein and Astrid Englezou

- Vertebrate Cell Culture II and Enzyme Technology: Volume 39 (Advances in Biochemical Engineering/ Biotechnology) by A.F. Bückmann and G. Carrea
- Animal Cell Culture and Technology (The Basics) (Garland Science)) by Michael Butler
- The Immortal Life of Henrietta Lacks by Rebecca Skloot

BIC31005	Advanced Cancer Biology	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

UNIT I

Introduction to cancer, cancer gene discovery , tumorigenesis , cancer therapy and resistance , oncogenes , tumor suppressor genes , cancer models, growth control and cell proliferation, metastasis , cell proliferation , cell death , cell-cell and cell-matrix interactions , microenvironment.

UNIT II

DNA repair and replication , transcription , chromosome stability , metabolism , immunology and cancer, immuno therapy, cancer stem cells, modern techniques in detection of cancer.

UNIT II

Cellular basis of carcinogenesis, Cell signalling in carcinogenesis, Multistep carcinogenesis, Modern treatment modalities arising from cancer cell biology. The hallmarks of cancer. Techniques for detecting cancer. Special emphasis on breast, blood, colorectal, lung cancer. Advanced therapies on the horizon.

UNIT IV

Advanced cancer research focus areas; Cancer disparities, Cancer stem cell therapies- understanding and implementation, Cancer systems biology-advanced experimental models, insights from genome sequencing and other large scale data projects. Computational models for cancer prediction.

Suggested Readings:

- 1) Oxford Textbook of Cancer Biology. Francesco Pezzella, Mahvash Tavassoli, David Kerr · 2019.
- 2) Introduction to Cancer Biology, books.google.co.in › books, Robin Hesketh · 2013.
- 3) Advanced Computational Methods for Oncological Image Analysis Hardcover –2021 by Leonardo Rundo (Editor), Carmelo Militello (Editor), Vincenzo Conti (Editor)

BIC31006	Advanced Techniques in Plant Biochemistry and Biotechnology	L	T	P	C
Version 1.0	Contact Hours - 60	4	0	0	4

UNIT I

Primary and Secondary metabolites: Photosynthesis: CO₂ fixation-CAM, C₄, and C₃ pathways, photo protective mechanisms, mechanisms of electron transport, light-harvesting complexes. Respiration & Photorespiration: ATP synthesis & plant mitochondrial electron transport, citric acid cycle. Nitrogen Metabolism. Biosynthesis of nitrogenous compounds, phenols, and terpenes & their roles. Advanced techniques in identification and quantification of metabolites. Medicinal plant research.

UNIT II

Plant tissue culture: Cell and callus culture, anther culture. Micropropagation, somatic cell hybridization, protoplast fusion, cybrids, artificial seeds, Agrobacterium mediated gene transfer and use of Ti plasmid. Applications of plant tissue culture engineering, pathogen resistance (BT gene), herbicide tolerance, salt tolerance, production of secondary metabolites and transgenic plants.

UNIT III

Advances in Stress Physiology research: Plant responses to abiotic & biotic stresses. Molecular adaptation and generation of stress tolerant plants. Different case studies. Food safety research.

UNIT IV

Plant biotechnology in improvement of plant microbe interaction. PGPR research: Types and applications in agro industries. Characterization and bioengineering of PGPR.

Suggested Readings:

1. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford, 1983.
2. Plant Physiology, 5th Edition, by Lincoln Taiz and Eduardo Zeiger, Amazon press, 2012
3. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford.
4. Buchanan BB, Gruissem W & Jones RL. 2000. Biochemistry and Molecular Biology of Plants. 2nd Ed. John Wiley.
5. Dey PM & Harborne JB. 1997. Plant Biochemistry. Academic Press.
6. Heldt HS. 1997. Plant Biochemistry and Molecular Biology. Oxford Univ. Press.