



**Department of Biochemistry**  
(Supported by DST-FIST)  
**University of Kashmir**  
(NAAC Accredited A<sup>++</sup>)

**Syllabus for Course Work**  
**Ph. D Biochemistry**

**2025 Onwards**

Papers and Marks Details			
Paper	Code	Paper Name	Marks
Paper I	BCH-PHD- 01	Research Methodology	100
Paper II	BCH-PHD- 02	Recent Advances in Biochemistry	100
Paper III	BCH-PHD- 03	Specialized Paper	100

**Note:** The syllabus for paper III (Specialized Paper) shall be based on the recent developments in the area of research related to the thesis work of the scholar and shall be drafted by the concerned supervisor.

**PAPER I:**  
**RESEARCH METHODOLOGY**

**Paper Code:** BCH-PHD-01

**Marks:** 100

**Unit I: Research Design and Types**

- i. Meaning and motivation in research
- ii. Importance of literature reviewing in research
  - o Sources of Literature review
  - o Primary and secondary sources
  - o Reviews, treatise, monographs, patents
  - o Journals, books and internet recourses
  - o Identifying research gaps/areas from literature review
- iii. Formulating the research problem
  - o Selecting and identifying the research problem
  - o Rationale, originality and significance of research problem identified
  - o Hypothesis, important considerations while making a hypothesis
  - o Objectives and aims of research
- iv. Criteria of a good research
- v. Research process
  - o Methods vs Methodology
  - o Time line in research
- vi. Types of research
  - o Descriptive vs Analytical
  - o Applied vs Fundamental
  - o Quantitative and Qualitative
  - o Conceptual vs Empirical

**Unit II: Ethics in Research**

- i. Introduction to Bioethics
- ii. Ethical issues concerning various fields of biological research
  - o Embryonic stem cells and cloning
  - o Gene therapy and designer babies
  - o Genetically modified animals and crops
  - o Ethical limits of animal use and welfare
  - o Medical research ethics
- iii. Academic integrity, reproducibility and publication ethics
  - o Plagiarism
  - o Tools to check plagiarism
  - o Record keeping
  - o Responsible authorship and Publications
  - o Conflict of interest
  - o Mentor and mentee responsibilities and relationships
- iv. Committees

- Constituting or approaching the ethical/ethics committees
- Member and their mandate
- Research board, council, and Board of research studies
- Statutes and guidelines of UOK Ph. D program
- v. Laboratory safety
- vi. Management of laboratory waste

### **Unit III: Statistics in Research**

- i. Significance of statistics in biological research
- ii. Concepts of data
  - Tools for data collection
  - Data classification
  - Construction of schedules and questionnaires
  - Measurement of scales and indices
  - Pilot Studies and Pre-tests
- iii. Statistical approaches and significance
  - Measures of Central Tendency
  - Measures of dispersion
  - Probability
  - Binomial distribution
  - Poisson distribution
  - Normal distribution
  - Parametric and non-parametric tests
  - Measures of Association/Relationship
  - Regression and Correlation Analysis
  - Hypothesis Testing (For Proportion and Means)
  - Test of Significance
  - Chi-Square test
  - T-test and F-test
- iv. Sampling Techniques or Methods
  - Choice of Sampling Techniques
  - Sample Size
  - Sampling and Non-Sampling Errors
  - Observation Method
  - Experimentation
  - Simulation
  - Interviewing
  - Panel Method
  - Mail Survey
- v. Correlation and regression analysis
- vi. Knowledge of ANOVA and SPSS soft wares and their applications
- vii. Processing & Statistical Analysis of Data
  - Editing
  - Classification and Coding
  - Transcription
  - Tabulation

- Graphical Representation

viii. Introduction and use of the statistical software

- SPSS
- STATA
- SAS

**Unit IV: Research Techniques**

i. Molecular Interactions:

- Molecular Interaction by proximity labeling: protein-protein, protein-RNA, protein-DNA interactions;
- Measurement of genomic interactions and chromatin accessibility:
- Trac looping; eSGA (E.coli synthetic genetic array analysis)

ii. Microscopy:

- Cryo-EM
- STED super resolved-microscopy
- Expansion Microscopy
- Light sheet microscopy
- Atomic force microscopy
- Transmission electron microscopy (TEM)

iii. Single cell Biology:

- Single cell genomics
- Single cell transcriptomics
- Single cell proteomics; G&T Seq:
- parallel sequencing of single cell genomes and transcriptomes
- profiling metabolites and peptides in single cells

iv. Yeast Two Hybrid screening, FRET, FREP

v. ChIP, ChIP-Seq, DNA pull down assays

vi. Reporter assay (Luciferase reporter assay)

vii. Microplate capture and detection assay

**PAPER II:**  
**RECENT ADVANCES IN BIOCHEMISTRY**

**Paper Code:** BCH-PHD-02

**Marks:** 100

**Unit I: Gene Technology**

- i. Genome wide sequencing
  - o Whole genome
  - o Whole transcriptome sequencing
  - o Whole exome sequencing
  - o Whole epigenome sequencing
  - o Cr-Y2H-seq (Cre recombinase-yeast two hybrid-next generation sequencing)
- ii. Genome Wide association studies
- iii. Gene Silencing
- iv. RNA interference:
  - o siRNA, micro
  - o RNA and shRNA mediated gene silencing
  - o Ribozyme mediated gene silencing
  - o Cre-Lox recombination system in gene knockout approaches
  - o CRISPR-Cas9 in gene silencing and knockout approaches
  - o Genome editing with: CRISPR-Cas9 technology
  - o TALEN system, Zinc finger system
- v. Transgenic plants

**Unit II: Tissue Culture**

- i. Animal culture
  - o Media requirements and sterilization techniques
  - o Primary and established cell lines
  - o Culture methods
  - o Hanging drop, monolayer and suspension
  - o Advantages and disadvantages of above methods
  - o Scale up methods
  - o Roux tubes roller bottles
- ii. Stem cells
  - o Adult and embryonic stems cells
  - o Application of tissue engineering
  - o Application of animal cells
- iii. Plant tissue culture
  - o Cell and callus culture
  - o Anther culture
- iv. Micropropagation
- v. Somatic cell hybridization
- vi. Protoplast fusion, Cybrids
- vii. Artificial seeds
- viii. Agrobacteria mediated gene transfer and use of Ti Plasmid
- ix. Application of plant tissue culture engineering
  - o Pathogen resistance (BT gene)

- Herbicide tolerance
- Salt tolerance

### **Unit III: Drugs and Vaccines**

- Concept of therapy/treatment and types of therapies
  - Conventional therapy- non-specific: efficacy, limitations
  - Targeted therapy- small molecule and antibody types (Immunological techniques)
  - Concept of Personalized therapy/medicine
  - Gene panel and role of omics in personalized medicine
  - Development of diagnostic panel and markers
- Omics importance in health and research
  - Approaches
  - Potential of understanding disease biology
  - Scope in drug development
- Medicinal plants -Potential sources of medicines
- Approaches in isolation and characterization of novel plant based bioactives
- Drug resistance challenges in infections and cancers therapies
- Vaccine development
  - Types, approaches and targets
  - Vaccines scenario for HIV, HPV, influenza, tuberculosis, SARS/II and Flues)

### **Unit IV: Bioinformatics**

- Role of bioinformatics
  - Biological research
  - Drug Development
  - Vaccine Development
- Sequence alignments
  - Introduction
  - Protein sequences
  - Pairwise sequence alignment
  - Gaps and Gap-penalties,
  - Scoring matrices
  - Multiple seq. alignment, comparison, composition and properties
  - Useful tools – Clustal W, BioEdit, BlastTp
  - Phylogenetic analysis tools – Phylip, ClustalW, Online phylogenetic analysis
- Biological Bases and uses
  - European Molecular biology laboratory
  - GeneBank
  - Nucleotide Seq databank
  - DNA data bank of japan
- Protein data bases
  - Primary and secondary data bases
  - Database formats
  - structural data bases
  - Protein data bank
  - Molecular model bank

- Protein-Protein interaction detection tools and data bases
- v. Tools for primer designs
- vi. Citation management tools
  - Mendeley
  - Easybib.com
  - Endnote
  - Read Cube Papers
  - Zotero
  - RefWorks