# Pre. Ph.D. Course Work
# Department of Biotechnology
# Faculty of Life Sciences
# Jamia Millia Islamia

Structure of Pre. Ph.D. Course Work.

| S. No. | Paper Code | Title | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|
| | | | | Internal Assessment | University Exam | Total |
| 1 | PBT-101 | Research Methodology | 4 | 40 | 60 | 100 |
| 2 | PBT-102 | Research Project, Review & Annotated Bibliography | 4 | | 100 | 100 |
| 3 | PBT-103 | Genomics (Core Subject) | 3 | 30 | 45 | 75 |
| 4 | PBT-104 | Molecular Medicine (Core Subject) | 3 | 30 | 45 | 75 |
| 5 | PBT-105 | Industrial Biotechnology (Core Subject) | 3 | 30 | 45 | 75 |
| 6 | PBT-106 | Biotechniques (Core Subject) | 3 | 30 | 45 | 75 |

26/10/20

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Professor & Head

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# RESEARCH METHODOLOGY

Code: PBT-101 M.M: 100

Credit:04

Unit I: Introduction to Research Methodology: Meaning of Research, Objectives of Research, Types of Research, Significance of Research. Types of Sampling: Probability sampling and non-probability sampling. Measurement and Scaling Techniques: Measurement in Research, Measurement Scales (Ordinal, Nominal, Interval, and Ratio Scale), Tests of Sound Measurement (Validity, Reliability, and Objectivity/Practicality).

Unit II: Data: Types of data and methods of data collection, Measures of dispersion, Simple correlation, Regression analysis, Tests of significance-F-test, paired and unpaired t-test, Chi-square test and its applications, Analysis of variance (ANOVA),

Unit III: Bioethics and Biosafety: Good Laboratory Practices (GLP), Bioethics in Biotechnology: meaning, history, purpose & scope, principle, medical ethics, and issues. Biosafety and Biosafety levels: BSL-I, BSL-II, BSL-III, and BSL-IV. Various Laboratory hazards: Radiation, Chemicals Pathogens and Microorganisms and precautionary measures, Laboratory cultures and laboratory animals. Gentically modified organisms.

Unit IV: Bioinformatics: Types of biological data, Biological Databases: Nucleic acid and protein sequence and protein structure databases, Bioinformatic tools DNA sequence analysis (DSA), Sequence annotations and sequence analysis, Phylogenic analyses. Protein Data Bank (PDB), File formats and their interconversions, Primer designing and Tm Calculation, Molecular markers.

*Recommended Books:*


1. *Research Methodology by C. R Kothari*
2. *A text book of bioinformatics (2008) Sharma, Munjal and Shankar. Rastogi Publications, Meerut.*
3. *An introduction to Bioinformatics Algorithms (2004) Neil Jones, Pavel Pevzner A, Bradford Book, The MIT Press, USA*

# GENOMICS

Code: P6T-103 M.M: 75

Credit:03

## Unit I. Organization of genomes

Introduction: genome. genomics, omics and their importance, general features, C-value paradox, gene identification, gene prediction rules and software: genome databases; annotation of the genome. Genome diversity: taxonomy and significance of genomes and genomoics of bacteria, yeast, C. elegans, Homo sapiens, Arabidopsis spp, etc. synthetic genomes and their applications.

## Unit II. Genome Projects

The Human Genome Projects, HapMap Project, the 1000 genome project, and the ENCODE project. Structural genomics: assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole-genome shotgun sequencing. Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes, and studying the activity of a protein through reverse genetics.

## Unit III. Genome Mapping and Functional Genomics

Genetic mapping- i) Crossbreeding and pedigree analysis, ii) DNA markers- RFLPs, SSLPs, SNPs. Physical mapping: restriction mapping, RAPD, Radiation hybrid mapping, and sequence-tagged site mapping. Structural genomics, pharmacogenomics, drug detoxification genes, Comparative genomics, functional genomics, Genomes and Genomics of Chloroplast and Mitochondria.

*Recommended Book:*

1. *Genome by TA Brown*

# MOLECULAR MEDICINE

Code: PBT 104 M.M: 75

Credit:03

**Unit-I:** Gene Therapy Strategies: History and scope of gene therapy, Types of gene therapies; Somatic and germ lines, Gene replacement and gene addition, In vivo, ex vivo, and in vitro gene therapies. Gene therapy vectors: Viral vectors: Retrovirus, Adenovirus, Adeno-associated virus, Lentivirus, Nonviral vectors; Naked DNA, Liposomes and lipoplexes, Transposons and their significance. Gene editing methods: Cre-Lox system, ZFNs, TALENs, and CRISPR-Cas9 tools. RNAi and its significance.

**Unit-II:** Prenatal diagnosis and Neonatal screening- indications for prenatal diagnosis; pre-implantation genetic diagnosis; invasive techniques- amniocentesis, chorionic villi sampling (CVS); non-invasive techniques- ultrasonography and anomaly scans, Double Markers, Quadruple Markers, maternal serum screening and maternal lipid profile, Diagnosis using protein and enzyme markers (PKU - Guthrie test), neonatal screening.

**Unit-III:** Gene Therapy for Human Diseases: Gene therapies for Hemophilia B, B-Thalassemia, CML and Sickle cell disease, Cystic fibrosis, Duchene Muscular Dystrophy, Inherited neurological disorders, Inherited retinal disorders, Tyrosinemia, Severe Combined Immunodeficiency syndrome- (SCID). Clinical trials and FDA approval process. Personalised medicine.

*Recommended Books:*


1. *Principles of Genetics in Medicine by Thompson and Thompson*
2. *Introduction to Human Molecular Genetics- J.J Pasternak, John Wiley Publishers*
3. *Human Molecular Genetics- Tom Strachen and A P Read, Bios Scientific Publishers*
4. *Human Genetics Molecular Evolution- Mc Conkey*

# INDUSTRIAL BIOTECHNOLOGY

Code: PBT-105 M.M: 75

Credit:03

**Unit-I:** Industrial Biotechnology Systems: Selection of microorganisms: Genetic manipulation and potential problems of genetic engineering, preservation of microorganisms. The rationale for the design of vectors for the over-expression of recombinant proteins in microorganisms: selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, Purification tags, protease cleavage sites & enzymes, and inducible expression systems.

**Unit-II:** Overexpression model systems: E. coli, Yeast, Baculovirus, Agrobacterium tumefaciens, oral vaccines. Drug Discovery in Microbial Metabolites: Processes of Drug Discovery- Cell-based Assays, Receptor Binding Assays, Enzyme Assays, Computer Aided Drug Design. Biosensors, Biopesticides, Petroleum microbiology. Production of monoclonal antibodies.

**Unit-III:** Product and Processes in Industrial Biotechnology: Industrial production of lactic acid, vinegar, insulin, alcohol, baker's yeast, antibiotics, and enzymes. Fermented foods: Milk, cheese, meat, alcoholic beverages, bread, and Single Cell Proteins (SCP). Controlling food spoilage: aseptic handling, low-temperature, high-temperature, dehydration, chemical-based preservation, radiation, and osmotic pressure. Food-borne diseases: Food-borne infections, intoxications.

*Recommended Books:*


1. *Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi*
2. *Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentationtechnology, Pergamon press*
3. *Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.*
4. *Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi*
5. *Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVItech books.*

# BIOTECHNIQUES

Code: PBT-106 M.M: 75

Credit:03

## UNIT-I: Biophysical and Biochemical Techniques

Chromatography: Principle, normal and reverse phase liquid chromatography, ion exchange. molecular exclusion, affinity chromatography, HPLC, HP-TLC, GLC, ICP-MS; Electrophoresis Techniques: principle, Support media (agarose and polyacrylamide gels), agarose gel electrophoresis of DNA and RNA, southern and northern blot, PFGE, Native PAGE, SDS-PAGE; Centrifugation Techniques: Principle of sedimentation, centrifugation, ultracentrifugation, analytical centrifugation, preparative centrifugation, general applications of centrifugation; Spectrophotometry Techniques: theory and applications of CD, UV-VIS, IR, Fluorescence, Atomic absorption spectroscopy, FRET and its application

## UNIT-II: Histology and Microscopic Techniques and Radio-isotopes Techniques

Fixation of tissue, cell culture, Magnification and resolution of microscopes, components of a light microscope, Theory and principles of microscopy, light, dark field, fluorescence microscopy, TEM, SEM, confocal microscopy, microtomy, ultramicrotomy, freeze fracturing, flow cytometry. Radioactivity and radioisotopes, rate of decay, units of radioactivity, specific activity, Detection, and measurement of radioactivity Cerenkov counting and autoradiography, Applications in biological sciences - Analytical, diagnostics and metabolic studies, Safety aspects of radioactive handling, alternatives to radiolabelling.

**UNIT-III:** Genetic engineering, Immunology, and Molecular Biology Techniques Extraction of DNA, cellular screening, Polymerase Chain Reaction, DNA sequencing, DNA synthesis, bacterial transformation, molecular hybridization, FISH, Chromosomal banding and painting, Karyotyping, cloning techniques, r DNA Expression techniques; Preparation of culture media, Cell culture methods, types of culture media, Culture of micro-organisms, Sterilization, Dilution technique for plate count, Enumeration techniques. Immunohistochemistry.

*Recommended Books:*


1. *Microbiology by Prescott, Harley, Klein (McGraw Hill).*
2. *Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker*