

Department of Biotechnology
Faculty of Science
V. B. S. Purvanchal University Jaunpur

Course work for Ph.D. Students

There shall be four courses to be read by all the provisionally enrolled Ph. D. Students of the Department of Biotechnology. These courses will be equivalent to one semester and the students will have to qualify this examination (with 50% marks) within a maximum period of two years before the final enrolment. The examination for the course work shall be held twice, normally in December and May months of each academic session. In case a student fails to qualify this examination, his/her enrolment will be automatically cancelled.

Course 1: (Faculty specific, Compulsory : 3 credits) Research Methodology

Course 2: (Department specific, Compulsory; 5 credits)

A. Basic techniques used in Biotechnology and their applications (3 credits)

B. Bioinformatics and Biostatistics (2 credits)

Course 3 and 4: (research specific; 5 credits)

Course 3: Any one of the two following elective courses

3.1. Advance Cell and Molecular Biology (2 credits)

3.2. Mushroom Biotechnology (2 credits)

Course 4: A: Review of Literature, submission in bound form (3000-5000 words) and presentation of a published research paper (open to all; to be evaluated by RPC, 2 credit)

4 B. Project writing and presentation (open to all; to be evaluated by RPC, 1 credit)

Note: 1 credit=13-15 lectures.

The details of the courses outlined above are given below.

Course 1: Research Methodology

Unit I: Objective of research. Research problem and techniques involved in defining a problem. Steps of scientific study, Formulation of hypothesis, defining sources, workable hypothesis, Basic concept of research design.

Unit II: Survey, case study (if required), Experimental methods, Interdisciplinary approaches.

Unit III: Collection, Classification and tabulation of data, Measures of central tendency, Chi-square test.

Unit IV: Analysis and interpretation of data, techniques of interpretation, Steps of report/ review/ research paper writing, layout and presentation of report.

Unit V-A: Introduction to computer, types of computers and components of computer. Role of computer in research.

Unit V-A: Concept of languages, language suitable in scientific research.

Unit V-C: MS office tools (access, excel, power point, word).

Unit V-D: Introduction to internet, different parts of internet, application of internet.

Unit V-E: Introduction of soft-wares, software commonly used in scientific research (Sigma-plot, Enzfitter, BLAST etc.).

Unit V-F: Studying various national R and D agencies (CSIR, ICMR, DST, DBT, UGC, ICAR etc.) to find out their priority areas and thrust areas.

Recommended readings:

Research Methodology: Methods and techniques by Kothari, CR (2007); New Age International Pvt. Ltd.

Research Methodology by Panneerselvam, R (2007); Prentice Hall India (P) Ltd.

Quantitative Methods; ICFAI University Press (2004).

Instrumental Methods of Analysis: by HH Willard, Merritt, Jr.LL, Dean , JA & Settle, Jr. FA; CBS Publishers and Distributors (1986).

Business Statistics by Bhardwaj, RS; Excel Books. Statistical Methods by Shenoy, GV and Pant, LM (1994); MacMillan India Ltd.

Course 2A. Basic techniques used in Biotechnology and their applications (3 credits)

Basic Techniques: General safety measures, chemical hazards, physical hazards, biological hazards, spillage and waste disposal, first aid.

pH and buffers: Acids and bases, titration curves.

Chromatography: Paper and TLC Column Chromatography.

Electrophoresis: Agarose and polyacrylamide (native and SDS-PAGE) gel electrophoresis.

Spectrophotometry: Colorimetry, UV-visible spectrophotometry, Atomic absorption spectrophotometry.

Biochemical assay: Carbohydrates, lipids, proteins and nucleic acids.

Microscopic techniques: Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM , FACS.

Microbial techniques: Isolation, purification, characterization (morphological, biochemical and molecular) of microbes.

Immunological Techniques: Precipitation and agglutination reactions, ELISA, RIA, hybridoma technology, immunofluorescence, FISH.

Animal Cell Culture: Culture media, basic culture techniques and maintenance primary cultures and cell lines.

Plant Tissue Culture: Culture media, establishment and maintenance of Cultures, Totipotency.

General applications of biotechnology in industry. Role of biotechnology in agriculture and crop improvement. Biofuels, Biofertilizers, Biopesticides and Biosensors. Stem cells and Gene therapy.

Recommended Readings:

Principles and Techniques of Biochemistry and Molecular Biology: Keith Wilson & John Walker (2006) Cambridge Univ Press.

Biochemistry: D Voet and JG Voet, John Wiley and Sons. 4th Edn. 2010.

Boyer (2005) Modern Experimental Biochemistry and Molecular Biology: Boyer (2005).

Molecular Biology of the Cell: Bruce Albert Et al., Garland Science, NY

An Introduction to Plant Tissue culture: MK Razdan, Oxford India.

Plant Tissue Culture: Kalyan Kumar Dey. The New central Book Agency Calcutta.

Animal Cell Culture Techniques: Martin Clynes (Ed.), Springer.

Culture of Animal Cells: RI Freshney, wiley-Liss. John W & Sons Microbiology (VII Edn.): LM Prescott, JP Harley & DA Klein, McGraw Hill.

Alcamo's Fundamentals of Microbiology (8th Edn.): Jeffrey C. Pommerville, Jones and Bartlett Publishers.

Course 2 B: Section 1: Bioinformatics

1. Introduction to computers, networks and information technology. 1
2. Introduction and scope of Bioinformatics: A concept of digital laboratory. 1
3. Introduction to data archiving systems: FASTA format, Accession, and GI-Number. 1
4. Biological databases, primary, secondary and composite database, nucleotide-, protein- and structural sequence databases. 5
5. Gene identification and genome annotation. 1
6. Dynamic programming: Score function, substitution matrices (PAM, BLOSUM) and gap penalties, Needleman- Wunsch algorithm, Smith- Waterman algorithm. 2
7. Local and multiple sequence alignment and Phylogenetics: Clustal-W. 1
8. Protein structure bioinformatics: Protein prediction, structure comparison, homology modeling. 2

Suggested Readings

Barnes & Gray (2003) Bioinformatics for Geneticists. Wiley
Campbel (2006) Discovering Genomics, Proteomics and Bioinformatics. LPE
Hunt & Livesey (2006) Functional Genomics. Oxford
Lesk (2006) Bioinformatics 2/e. Oxford
Mount (2006) Bioinformatics 2/e. CBS
Westhead et al (2003) Bioinformatics Instant Notes. Viva Books (Indian ed)

Course 2B: Section 2: Biostatistics

1. Collection and classification of data, Graphical presentation of qualitative and quantitative data (Bar diagram, Pie diagram, Histogram, Frequency polygon, frequency curve and ogive, and box plot) 2
2. Measures of central tendency (mean, median and mode), measures of dispersion (variance and standard deviation), concept of coefficient of variation, skewness and kurtosis 3
3. Correlation (continuous data and ordinal data) and regression (linear and curvilinear), concept of coefficient of determination 2
4. Concept of probability 1
5. Concept of standard error and p value, parametric test (Z and t, both paired non-parametric and unpaired) and test (Chi-square) 3
6. Analysis of variance: one way and multiple comparison, post-hoc tests 2

Suggested Readings

Bruning & Kintz (1977) Computational Handbook of Statistics. Scott
Daniel (2000) Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley.
Milton & Tsokos (1983) Statistical Methods in the Biological and Health Sciences. McGraw Hill
Quinn & Keough (2002) Experimental Design and Data Analysis for Biologists. Cambridge Univ
Rastogi (2008) Fundamentals of Biostatistics. ANE Books
Sharma (2008) Text Book of Biostatistics-I&II. Discovery Publishing
Snedecor & Cochran (1968) Statistical Methods. Oxford & IBH

Sokal & Rohlf (2000) Biometry. Freeman.

Steel & Torrie (1980) Principles and Procedure of Statistics: A Biometrical Approach. McGraw Hill Book Co.

Zar (2003) Biostatistical Analysis. Pearson

Course 3.1: Advanced Molecular Biology:

A general introduction to recent advances in cell and molecular biology and landmark discoveries in molecular biology.

DNA in Chromosomes: Structure & function of DNA, packaging of DNA in chromatin filaments, chromosomal DNA elements, their variations and diseases. Global structure of chromosomes, replication origins, centromeres, telomeres.

Yeast as a model system to study Cell cycle and its regulation, gene function & pathogenesis.

Molecular Biology and Recombinant DNA methods:

Basic principles of isolation of RNA, DNA and proteins, DNA sequencing, next generation sequencing, PCR, real time PCR analysis, Southern, Northern and western blot analysis, In vitro mutagenesis and deletion techniques, Targeted gene knock-out. DNA microarray, chromatin immunoprecipitation (ChIP).

Books Recommended:

Molecular Biology of the Gene: JD Watson et al., Pearson Education (Singapore) Pvt. Ltd., Delhi.

Molecular Biology of the Cell: Bruce Albert Et al., Garland Science, NY

Molecular Cell Biology: Lodish et al. WH Freeman & Co., NY

Principles of Gene Manipulation (6th edn.): SB Primrose, RM Twyman and RW Old, Blackwell Science.

Principles of Gene Manipulation and Genomics: SB Primrose and RM Twyman, Blackwell Publishing.

Molecular Cloning: Sambrook et al., Cold Spring Harbor Laboratory, NY.

Course 3.2: MUSHROOM BIOTECHNOLOGY

1. An Introduction to mushroom biotechnology: Habitat, general characteristics, type and classification of mushroom
2. Biodegradation and bioremediation of organic recalcitrant and xenobiotics by *Pleurotus* species
3. Developmental biology and genetics of morphogenesis in model mushroom fungi.
4. Important mushrooms of commerce and their production methods
5. Nutritive and medicinal values of mushrooms
6. Molecular tools for strain improvement including protoplast technology, and their evaluation with reference to *Agaricus* and *Pleurotus*.
7. Mushrooms as a bio-indicator of health of eco-system, and their biodiversity
8. Strategy for isolation of mushroom inducing genes of edible mushrooms.

Books Recommended:

1. Genetics & Breeding of Edible Mushrooms- Chang et al., Gordon & Breach Publication, USA
2. Recent Trends in Biotechnology Volume I, Singh et al., Nova Science Publisher, Ny, USA.
3. Advances in Horticulture Vol. 13. – Chaddha and Sharma, Malhotra Publishing House, New Delhi
4. Mushrooms: Poisons and Pancreas—D. R. Benzamin; W. H. Freeman and Co. N.Y., USA.
5. Current visits in Mushroom Biol. And Production- Upadhyay et al., NRCM, Solan.
6. Molecular and Cellular Biology of Filamentous Fungi: A Practical Approach. Nick Talbot, Oxford University Press, 1999.