



TECHNO INDIA UNIVERSITY
WESTBENGAL

Proposed Syllabus for 4-year B.Sc (Honours with or without research) (NEP)

2023

MICROBIOLOGY



Department of Microbiology

**Techno India University, West Bengal
EM-4, EM Block, Sector V, Bidhannagar,
Kolkata, West Bengal 700091**



Semester VII (Without Research)

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
Theory							
1.		Major: Instrumentation and Biotechniques	2	1		3	
2.		Major: Essential Tools in Biological Research	2	1		3	
3.		Major: Medical Biotechnology	2	1		3	
		Major: Microbes in Sustainable Agriculture and Development	2	1		3	
Practical							
4.		Major: Instrumentation and Biotechniques			1	1	
5.		Major: Essential Tools in Biological Research			1	1	
6.		Major: Medical Biotechnology			1	1	
7.		Major: Microbes in Sustainable Agriculture and Development			1	1	
Total Credit						16	

Semester VII

Core Subject:

Course Name : Instrumentation and Biotechniques (Theory)

Course Code:

Course Details:

Unit I: Chromatography:

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography, Column packing and fraction collection. Gel filtration chromatography, ion[1]exchange chromatography and affinity chromatography, GLC, HPLC

Unit 2: Electrophoresis:

Theory of electrophoresis: Moving boundary and zone electrophoresis, Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis, Gradient Electrophoresis, Immunoelectrophoresis, Instrumentation for Southern and Western Blot.



Unit 3: Spectrophotometry:

Interaction of Electromagnetic radiation with matter: scattering and absorption, Principles and applications of absorption spectra, Instrumentation of UV-Vis absorption spectrophotometer, Analysis of biomolecules using UV-Vis spectroscopy, Colorimetry and turbidometry, Introduction to emission spectroscopy: Fluorescence and Phosphorescence and their applications in biology.

Unit 4: Sedimentation:

Principles of sedimentation: Boundary and Zone sedimentation; Factors affecting sedimentation velocity and sedimentation co-efficient Preparative and analytical centrifugation, RCF and sedimentation coefficient, determination of molecular weight from sedimentation, differential centrifugation, density gradient centrifugation and ultracentrifugation and their applications, eukaryotic cell fractionation.

Unit 5: Mass Spectrometry:

Principles of mass spectrometry, m/z ratio, time of Flight analysis, MALDI and ESI Mass spectrometry, Mass spectrometry as an indispensable tool for Proteomics

SUGGESTED READING

1. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, 2010.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition, ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
6. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

Course Name : Instrumentation and Biotechniques (Practical)

Course Code:

Course Details:

1. Separation of amino acids by paper / thin layer chromatography.
2. Separation of proteins by gel filtration chromatography



3. Determination of molecular weight of a protein by SDS-Polyacrylamide Gel Electrophoresis (PAGE).
4. Determination of λ_{max} for an unknown sample and calculation of extinction coefficient.

Course Name : ESSENTIAL TOOLS IN BIOLOGICAL RESEARCH (Theory)

Course Code:

Course Details:

Unit 1 Use of statistics in Biological research

Principles of statistical analysis of biological data. Scope of statistics: utility in biological research. Sampling parameters: Difference between sample and population, difference between parametric and non-parametric statistics; Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom; Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Dependent and independent variables, Curve Fitting, Correlation and Regression. Mean and Variance of Discrete and Continuous Distributions: Binomial, Poisson, and Normal distribution. Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test; ANOVA and its applications.

Unit 2 Fundamentals of Bioinformatics

Sequence Alignments, Phylogeny and Phylogenetic trees Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood. Types of biological databases: - Genome databases, Protein sequence and structure databases, gene expression databases, Database of metabolic pathways, Indexing databases and Citation databases, retrieval and handling of data from Biological databases.

Unit 3 Principles of Biosafety

Biosafety guidelines and regulations (National and International); GMOs LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

Unit 4 Introduction to Intellectual Property Rights

Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR - patentable and non patentables - patenting life - legal protection of biotechnological inventions World Intellectual Property Rights Organization (WIPO)

Unit 5 Documentation and presentation of biological data

The art of making presentations for oral and poster sessions in seminars/conferences/scientific meets. The art of scientific writing: numbers, units, abbreviations and nomenclature used in scientific writing. Types of scientific writings: Original Research articles, Short communications, Perspectives, Review/mini-reviews, Introduction to Academic misconduct/ plagiarism, development of practices to avoid plagiarism (including self-plagiarism)

SUGGESTED READING



1. Wilson and Walker's Principles and Techniques of Biochemistry And Molecular Biology Edited by Andreas Hofmann , Samuel Clokie First published 2018
2. Biostatistics & Research Methodology: G Nageswara Rao PharmaMed Press, 2018
3. Research Methodology for Biological science, Gurumani, N, MJP Publishers, 2020
4. Introduction to Biostatistics, Pranab K. Banerjee, S. Chand Publication, 2007
5. IPR, Biosafety And Bioethics 2013 Edition by Goel, Pearson

Course Name : ESSENTIAL TOOLS IN BIOLOGICAL RESEARCH (Practical)

Course Code:

Course Details:

Students will have to submit a project by using bioinformatic tools and statistical approaches on any aspect of biology. The project will be evaluated by the teachers of the college where the student is enrolled.

Course Name : Medical Biotechnology (Theory)

Course Code:

Course Details:

Unit 1 Vaccine Development

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Transfusion of immunocompetent cells, Stem cell therapy; Cell based vaccines. Introduction to immunodiagnosics – RIA, ELISA. New approaches for vaccine delivery; Engineering virus vectors for vaccination; Vaccines for specific targets; Tuberculosis Vaccine; Malaria Vaccine; HIV vaccine

Unit 2 Cancer

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers. Origin and Terminology, Oncogenes and Cancer Induction, Proto-Oncogenes and Oncogene, Metastasis and Malignant Transformation of Cells Cancer. Growth factors related to transformation. Telomerases. Detection using biochemical assays and tumor markers. Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer

Unit 3 Gene therapy

Somatic cell gene therapy and germline therapy, ex vivo and in vivo therapies; vectors used in gene therapy: viral vector: retroviruses, adenoviruses, adeno-associated viruses, lentiviruses; non-viral vector: naked DNA, polymersomes, polyplexes

Unit 4 Cell Culture

Introduction, cell culture laboratory-design, layout and maintenance. Equipment and Instrumentation. Methods of sterilization, types of culture media, composition, preparation and



metabolic functions. Role of CO₂, Serum, supplements, growth factors (EGF, PDGF). Serum and protein free defined media. Culture and maintenance of primary and established cell lines. Biology of cultured cells and culture environment, cell adhesion, cell proliferation and differentiation. Characterization of cultured cells, viability, cytotoxicity, growth parameters, cell death and Apoptosis. Expression of culture efficiency.

Unit 5 Gene Editing

Introduction to genetics and genetic engineering; RNA interference, limitations of genetic engineering; Genome engineering using Zinc Finger Nuclease (ZFN) Technology; Transcription activator-like effector nuclease (TALEN) Technology; Clustered regularly interspaced short palindromic repeats (CRISPR)/Cas9 technology: target identification, gRNA design, donor design, Applications in treating human diseases: Human cell engineering-Thalassemia, SCID, Hemophilia, etc; Disease modeling-Cancer, iPSc and animal models; Engineered immune cells for cancer therapy.

SUGGESTED READING

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Watson J.D.et al. Molecular Biology of Gene (6th Ed.) Publisher Benjamin Cummings, 2007.
4. Glick, B.R. and Pasternak J.J. Molecular Biotechnology.ASM Press, Washington DC, 2003.
5. Weinberg, R.A. "The Biology of Cancer" Garland Science, 2007
6. McDonald, F etal., " Molecular Biology of Cancer" IInd Edition. Taylor & Francis, 2004

Course Name : Medical Biotechnology (Practical)

Course Code:

Course Details:

Evaluation will be done internally on short review and powerpoint presentation.

1. Power point presentations on Safety aspects of cell culture, cell types and culture, knowledge about cell line sourcing, common methods and protocols for cell culture.
2. Visit to a tissue culture laboratory for exposure.
3. Submission of a short review on any cancer related topic to expose the students on how to review journal papers and make a comprehensive summary.

For B.Sc (Hons In Microbiology Without Research)

Course Name : Microbes in Sustainable Agriculture and Development (Theory)

Course Code:

Course Details:

Unit 1: Introduction to Agriculture and Sustainable Farming Practices:



An overview of agriculture, its significance in food production, and the need for sustainable farming practices.

Unit 2: Soil Microbiology

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

Unit 3 Mineralization of Organic & Inorganic Matter in Soil

Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Unit 4 Microbial Activity in Soil and Green House Gases

Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 5 Secondary Agriculture Biotechnology

Biotech feed, Silage, Bio manure, biogas, biofuels – advantages and processing parameters

Unit 6 GM crops

Benefits, pest and disease resistance, safety, public perception and debate, examples-Bt crops, golden rice, rainbow papaya.

SUGGESTED READING

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, 1st edition, Marcel Decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

Course Name : Microbes in Sustainable Agriculture and Development (Practical)

Course Code:

Course Details:

Isolation of plant growth promoting rhizobacteria-characterize by nitrogen fixing, siderophore production and phosphate solubilization potential.