

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

IBT – 501: Molecular Biology and Genetic Engineering

SECTION-1

UNIT-1: Molecular Biology techniques used in detection and expression studies:

- Gel Permeation: Characteristics desired for gel permeation; Application of Gel permeation; Ion Exchange chromatography (cation exchanger, anion exchanger), Electrophoresis; Agarose Gel Electrophoresis, PAGE, SDS-PAGE, 2 D Gel Electrophoresis (iso-electric focusing).
- Southern Hybridization, Northern Hybridization, Western Hybridization, PCR, RT PCR.

UNIT-2: 2.1 Nucleic acid and Peptide sequencing:

- DNA Sequencing: Chemical and automated methods and application.
- Peptide Sequencing: Principle and strategies for protein sequencing.
- Design of primer from amino acid sequences.
- Nucleic acid synthesis: Chemical and automated methods, fluorescence tag coupling to oligonucleotides.

2.2 Proteomics and genomics techniques:

- Different methods used for protein analysis.
- Identification of protein using different biochemical and biophysical methods.
- Biochips.

SECTION-2

UNIT-3 Tools of Genetic Engineering:

3.1 Cutting and Joining of DNA

- Outline of gene cloning
 - Restriction Endonucleases Types I, II, III, Nomenclature, Examples of some enzymes, SI nucleases.
 - DNA Ligases;
 - Other modifying enzymes: Alkaline phosphatases, Reverse Transcriptase, DNA polymerase, T4 polynucleotide kinase, Terminal transferase.
 - Use of Linkers and adaptors.

3.2 Cloning Vectors

- Bacterial Plasmid Vector: pBR 322 and pUC vectors.
- Agrobacterium based plasmid, Ti-DNA plasmid, Properties of Ti and Ri based plasmids.
- Bacteriophage vectors, phage λ insertion vector and replacement vector.
- Cosmids and phagemid vector
- Yeast plasmid vectors; Yeast integrative plasmid, Yeast episomal plasmid and Yeast replication plasmid.
- Yeast Artificial Chromosome, Bacterial Artificial Chromosome, Shuttle vector and expression vector.

UNIT-4 Strategies of Genetic Engineering:

Gene cloning in prokaryotes;

- Isolation of DNA to be cloned; Genomic library, cDNA library; Isolation of mRNA, reverse transcriptase, oligo dC tailing, Addition of oligo G primer, Synthesis of second strand of cDNA.
- Insertion of foreign DNA fragment into vector; linkers, adaptors and homopolymer tailing.
- Transformation and growth of cells.
- Selection of Clones; Insertion inactivation and Blue White screening, colony hybridization techniques.
- Expression of cloned DNA.

References:

1. Biotechnology: The Biological Principles by M. D. Trevan, S. Boffey, K.H. Goulding and P. Stanburry TATA McGraw Hill Publishing Company Limited, New Delhi
2. Biotechnology; Smith, Cambridge Press.
3. Advanced Molecular Biology; Twyman R.M.
4. Microbiology; Atlas R. M.
5. Microbiology- Prescott L.M.
6. Microbial Genetics; Freifilder D.
7. Principles of gene Manipulation; Old and Primrose
8. Principles of Gene Manipulation and Genome; Primrose and Twyman (7th Edition) Blackwell Publishing
9. A textbook of Biotechnology by R.C. Dubey

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

IBT – 502: Applied Microbiology

SECTION-1

UNIT-1: ENVIRONMENT MICROBIOLOGY:

- 1.1** Aeromicrobiology: **(Ref: Raina & Denial)**
 - 1.1.1 Introduction to aeromicrobiology.
 - 1.1.2 Origin and type of microorganisms in air.
 - 1.1.3 Microbial analysis of air.

- 1.2** Aquatic Microbiology: **(Ref: Raina)**
 - 1.2.1 Types of Aquatic Habitats.
 - 1.2.2 Fresh water ecosystem.
 - 1.2.3 Marine ecosystem.

- 1.3** Soil Microbiology: **(Ref: Raina)**
 - 1.3.1 The nature of soil.
 - 1.3.2 Factors affecting microbial abundance in soils.
 - 1.3.3 Microbial population of soil.
 - 1.3.4 Overview of soil borne diseases in Humans and plants.
 - 1.3.5 Microbial analysis of soil.

- 1.4** The Role of Microorganisms in Biogeochemical Cycles: **(Ref: Raina)**
 - 1.4.1 Carbon cycle.
 - 1.4.2 Nitrogen cycle.
 - 1.4.3 Phosphorus cycle.
 - 1.4.4 Sulphur cycle.
 - 1.4.5 Iron cycle.

UNIT-2: FOOD MICROBIOLOGY:

- 2.1** Food as a substrate for microorganisms.
- 2.2** Microbial flora of food.
- 2.3** Preservation of food: General principle and methods of food preservation.
- 2.4** Microbial fermentation in food products from plants:
 - 2.4.1 Bread.
 - 2.4.2 Sauerkraut.
- 2.5** Microbial fermentations in food products from milk:
 - 2.5.1 Fermented milk beverages.
 - 2.5.2 Cheese.
 - 2.5.3 Butter.

- 2.6 Microorganisms as food:
 - 2.6.1 S.C.P.
 - 2.6.2 Mushrooms.
- 2.7 Contamination and Spoilage of Food
- 2.8 Food borne illness:
 - 2.8.1 Microbial.
 - 2.8.2 Non-microbial.

SECTION-2

UNIT-3: INDUSTRIAL MICROBIOLOGY AND PRODUCT FORMATION:

- 3.1 Industrial microorganisms and their products: **(Ref: Brock, Bauman, A.H.Patel)**
 - 3.1.1 Properties of useful microorganisms.
 - 3.1.2 Primary and secondary metabolites.
- 3.2 Major products of Industrial microbiology: **(Ref: A.H.Patel)**
 - 3.2.1 List of industrial important microbial enzyme-Amylase.
 - 3.2.2 List of microbially produced aminoacids- Glutamic Acid.
 - 3.2.3 List of microbially produced chemicals- Acetic acid.
 - 3.2.4 List of microbially produced vitamins- Cyanocobalamin.
 - 3.2.5 List of microbially produced solvents- Acetone-Butanol.
- 3.3 Water and Waste Water Treatment: **(Ref: Raina)**
 - 3.3.1 Water quality testing.
 - 3.3.2 Treatment of Drinking water.
 - 3.3.3 Treatment of waste water.
 - 3.3.3.1 Municipal wastewater.
 - 3.3.3.2 Industrial waste water.
 - 3.3.3.3 Solid waste processing: Anaerobic sludge digestion & composting.

UNIT-4: BIOLOGICAL WARFARE AND BIOTERRORISM:

Ref: Bauman

- 4.1 Assessing microorganisms as potential agents of warfare or terror:
 - 4.1.1 Criteria for assessing biological threats to humans.
 - 4.1.2 Criteria for assessing biological threats to livestock and poultry.
 - 4.1.3 Criteria for assessing biological threats to agriculture crops.
- 4.2 Known microbial threats:
 - 4.2.1 Human pathogens.
 - 4.2.2 Animal pathogens.
 - 4.2.3 Plant pathogens.
- 4.3 Defense against Bioterrorism.
- 4.4 The role of recombinant DNA technology in Bioterrorism.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

IBT – 503: Introduction to Biotechnology

Note: General overview, significance and applications are to be given emphasis. In-depth studies will be covered in subsequent semesters.

SECTION-1

UNIT-1: Biotechnology: A general introduction and overview.

- Historical perspective.
- Biotechnology an interdisciplinary pursuit.
- Safety in Biotechnology.
- Problems of pathogenicity of organisms.
- Problems of Biologically active biotechnology products.
- Public perception of biotechnology.
- Ethical issues in biotechnology.

UNIT-2: Thrust areas of Biotechnology:

- rDNA and Genetic Engineering.
- Fermentation.
- Process engineering.
- Biofuels.
- Biocatalysts.
- Biopesticides and Biofertilizers.
- Biopolymers and Bioplastics.
- Plants and plant cell culture.
- Mammalian cell culture.
- Waste treatment management.
- Molecular farming.

SECTION-2

UNIT-3: Biotechnological spotlights:

- Hybrid Antibiotics.
- Cell Immobilization and Production of Biomolecules.
- Bioreactors and Products of L- amino acids.
- Hepatitis Vaccine production.
- Thaumatin- The intense sweetener.
- Human Plasminogen Activators.
- Release of Bioactive agents.
- High temperature resistance Proteases.

UNIT-4:

- **Biotechnology in Fisheries:**
 - Genetic requirement for transgenic fish.
 - Gene transfer technology in fish.

- **Biotechnology and Forestry:**
 - Forest resources.
 - Clonal propagation of forest trees.

- **Future challenges in Biotechnology:**
 - Competitive tobacco substitute.
 - Vaccines for common cold.
 - Reliable self diagnosis kits.
 - Site specific targeted drugs.

References:

1. Biotechnology: The Biological principles by M. D. Trevan, s. Boffey, K. H. Goulding and P. Stanburry TATA McGraw Hill publishing Company Limited, New Delhi.
2. Biotechnology: Smith, Cambridge Press.
3. Modern Concepts of Biotechnology by H. D. Kumar, Vikas Publishing House
4. Elements of Biotechnology by P. K. Gupta, Rastogi Publications.
5. Recombinant DNA Technology by J.D. Watson, J. Gilman, J. Witkowski & M. Zoller, 1992, 2nd edition, Scientific Americans Books, New York.
6. Biotechnology, Keshav Trehan
7. Biotechnology Fundamentals and Applications – S. S. Purohit.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

IBT – 504: Introduction to Computers and Bioinformatics

SECTION-1: Introduction to Computers:

UNIT-1:

- Introduction to Computers: Overview to computers and historical perspective.
- Software and hardware, operating system, network types and architecture.
- Structure and function of servers, multiple OS, data storage devices.
- Internet: Introduction to Internet applications, online services, communication types, WWW, HTML, web browser, search engines, static and dynamic web pages, data bases, literature search.
- Introduction to programming: Concepts of algorithm, flow chart, structure of programme, compilers.

UNIT-2:

- Database management system: Overview of RDMS, Advantages of RDMS over.
- DBMS, normalization, Oracle data types. Introduction to SQL, DDL, DML, & TCL.
- Commands, data language, data manipulation language.
- Set operators and function: Operators in SQL, set operators, joins- kind of joins, table aliases, sub queries, multiple and corrected sub queries, functions-single, group functions. Constraints, locks & table partitions, constraints-domain, views, partition view.

SECTION-2: Introduction to Bioinformatics:

UNIT-3:

- Historical developments of Bioinformatics.
- Biological data and its characteristics.

- Use of Computers in Bioinformatics.
- Scope and Challenges of Bioinformatics.
- General overview of Genomics and its applications.
- General overview of Proteomics and its applications.
- Introduction to Bioinformatics tools and Software.
- Information regarding Biological databases.
 - Primary Sequence databases.
 - Metabolic Pathway databases.
 - Protein Sequence database.
 - Protein Structure database.

UNIT-4:

- Application of Bioinformatics in:
 - Drug discovery and Drug development.
 - Molecular medicine.
 - Personalization medicine.
 - Gene therapy.
 - Forensic analysis.
 - Evolutionary studies.
 - Biodiversity.

References:

1. Orpita Basu, Simminder Kaur, Bioinformatics Databases, Tools and Algorithms, Oxford University Press - 2007.
2. Jean – Michel Claverie and Cedric Notredame. Bioinformatics A beginner's Guide, Wiley Publishing Inc. - 2003.
3. Zoe Lacroix and Terence Critchlow. Bioinformatics Managing Scientific data. Morgan Kaufmann Publisher – 2003.
4. Attawood T. K. and Parry – Smith D. J. Introduction to Bioinformatics Person Education - 2003.
5. C. S. V. Murthy, Bioinformatics, Himalaya Publishing House - 2004.
6. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press – 2003.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

IBT – 505: Immunology and Medical Microbiology

SECTION-1

UNIT-1: Immunity to Microbes:

(Ref: Cellular and Molecular Immunology by A. K. Abbas, 6th edition)

- 1.1 General features of immune response to microbes.
- 1.2 Immunity to extracellular bacteria.
- 1.3 Immunity to intracellular bacteria.
- 1.4 Immunity to fungi.
- 1.5 Immunity to viruses.
- 1.6 Immunity to parasites.

UNIT-2: Vaccines:

(Ref: Kuby's Immunology 6th edition)

- 2.1 Active and Passive immunization.
- 2.2 Designing vaccine for passive immunization.
- 2.3 Live, Attenuated vaccines.
- 2.4 Inactivated or Killed vaccines.
- 2.5 Subunit vaccines.
- 2.6 DNA vaccines.
- 2.7 Recombinant Vector vaccines.

SECTION-2

UNIT-3: Immunodeficiency:

(Ref: Cellular and Molecular Immunology by A. K. Abbas, 6th edition)

- 3.1 General features of Immunodeficiency Diseases.
- 3.2 Congenital (Primary) Immunodeficiency:
 - 3.2.1 Defects in Innate Immunity.
 - 3.2.2 Severe Combined Immunodeficiency.
 - 3.2.3 Defects in B cell Development and Activation.
 - 3.2.4 Defects in T cell Activation and Function.
 - 3.2.5 Therapeutic approaches.
- 3.3 Acquired (Secondary) Immunodeficiency.
- 3.4 HIV and AIDS:
 - 3.4.1 Molecular and Biological Features of HIV.
 - 3.4.2 Pathogenesis of HIV infection and AIDS.
 - 3.4.3 Clinical Features of HIV Diseases.
 - 3.4.4 Immune Response to HIV.
 - 3.4.5 Treatment, Prevention and Vaccine development against AIDS.

UNIT-4: Microbial Pathogens and Associated Diseases:

(Ref: Medical Microbiology by David Greenwood, 7th edition)

4.1 Bacterial pathogenicity.

4.2 Bacterial pathogens and associated diseases:

4.2.1 Mycobacterium.

4.2.2 Clostridium.

4.2.3 Salmonella.

4.3 Viral Pathogens and associated diseases:

4.3.1 Orthomyxoviruses.

4.3.2 Coronaviruses.

4.3.3 Transmissible Spongiform Encephalopathies.

4.4 Fungal Pathogens and associated diseases:

4.4.1 Fungal diseases in Man.

4.4.2 Superficial infections.

4.4.3 Subcutaneous infection.

4.4.4 Systemic Mycoses: Coccidiomycosis and Histoplasmosis.

4.5 Protozoa and Helminthes as Pathogens and their diseases:

4.5.1 Malaria Parasites.

4.5.2 *Entamoeba histolytica*.

4.5.3 *Wuchereria bancrofti*.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

PRACTICALS

IBT – 506

Molecular Biology and Genetic Engineering

1. Isolation of Lactose non fermenting mutant of *E. coli* by physical mutagenesis using Ultra Violet Rays.
2. Isolation of Auxotrophic mutants of *E. coli* by chemical mutagenesis.
3. Isolation of drug resistant mutants of *E. coli* by Gradient plate technique.
4. Isolation of Petite mutants of yeast- *Saccharomyces cerevisiae*.
5. Extraction, Isolation and Characterization of DNA from *E. coli*.
6. Isolation and quantification of RNA from Yeast
7. Isolation of plasmid DNA by alkaline lysis method.
8. Transformation of plasmid DNA.
9. Conjugation of *E. coli* by plate method.
10. Induction of β -galactosidase in *E. coli*.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

PRACTICALS

IBT – 507

Applied Microbiology and Immunology

Applied Microbiology

- 1. Bacteriological analysis of water:**
 - Standard Plate Count.
 - Test for coliforms: (Presumptive, Confirmed and Completed tests).
 - Enumeration of Coliforms by MPN technique.
 - Determination of BOD and COD of water.
- 2. Bacteriological analysis of milk:**
 - Methylene Blue Reduction Test (**MBRT**).
 - Resazurin Reduction Test.
 - Detection of Acid fast organisms.
- 3.** Isolation of Symbiotic nitrogen fixing Rhizobium from root nodules.
- 4.** Isolation of Nonsymbiotic nitrogen fixing bacteria.
- 5.** Isolation and Identification of soil fungi (Mucor, Rhizopus, Aspergillus, Penicillium and Fusarium).
- 6.** Isolation and Identification of soil actinomycetes.
- 7.** To set up soil ecosystem using a Winogradsky column.

Immunology

- 1.** ELISA for detection of HIV.
- 2.** Immunologic pregnancy test.
- 3.** Detection of Hepatitis B surface antigen.
- 4.** Detection of Hepatitis B surface antigen by direct ELISA.

References:

- Aneja, K. R. (2007). Experiment in Microbiology, Plant Pathology and Biotechnology, 4th edition, New Age International Publishers.
- Cappuccino Sherman (2007). Microbiology-A laboratory manual, 7th edition.
- Patel, R. J. (2006). Experimental Microbiology, Aditya, Ahmedabad.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

Syllabus: Semester -V

PRACTICALS

IBT – 508

Computers and Bioinformatics

1. Introduction to HTML.
2. Literature access through internet.
3. Introduction to database search.
4. Nucleotide sequence retrieval.
5. Protein sequence retrieval.
6. Protein structure retrieval.
7. Protein visualization-RASMOL.
8. Metabolic pathway database-KEGG.