VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M. Sc. Integrated Biotechnology
Syllabus: Semester -VIII

IBT – 801: BIOPROCESS TECHNOLOGY - II

UNIT – 1

1.1 Introduction: Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing.

1.2 Substrates for bioconversion processes and design of media.

1.3 Isolation, improvement and preservation of industrially important microorganisms.

1.4 General consideration: Metabolic pathways and metabolic control mechanisms, Primary and secondary metabolites.

UNIT – 2

2.1 Production and commercial aspects of Primary metabolites:

Amino acids : L-Glutamate and L-Lysine.

Organic acids : Citric acid, Gluconic acid and Lactic acid.

Polysaccharides : General properties and production overview.

Vitamins : B_2 and B_{12}.

UNIT – 3

3.1 Production and commercial aspects of Secondary metabolites and Biomass:

Antibiotics : Biosynthesis, Strain improvement, Genetic engineering and production aspects of:

- Penicillins & Cephalosporins.
- Aminoglycosides:Streptomycins & Tetracyclines.

Microbial Biomass: Baker's yeast, SCP.

UNIT – 4

Biotransformation:

Introduction: Biotransformation of steroids and sterols.

Transformation of non-steroidal compounds.

Synthesis of chemicals using enzymes:

Introduction: Hydrolytic enzymes, Chiral building blocks for synthesis, Oxidations and Reduction.

REFERENCES:

1. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
2. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.
5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.
6. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.
7. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
8. Microbial Biotechnology: Channarayaappa, University press, Hyderabd, 2003
9. Basic Biotechnology by Colin Ratledge and Bjorn Kristiansen : 2nd Edition, Cambridge University Press.

IBT – 802: AQUACULTURE TECHNOLOGY

UNIT – 1

1.1 **Aquaculture Biotechnology**: Introduction, Application, Scope, Hormone Therapy, Feed Development, Vaccine Development and Environmental Aspects.

1.2 **Biotechnology in Fisheries Development**:
(Application of Biotechnology in Hatcheries, use of microbial Bio-fertilizers for sustainable aquaculture)

- Application of Biotechnology in fish food processing centers – Microorganisms responsible for fish spoilage – diagnosis, prevention and control, use of microorganisms in fisheries products, methods for the detection of spoilage and food poisoning in seafood.

1.3 **Marine Biotechnology:** Risk and Benefits.

UNIT – 2

2.1 **Genetic modification of fish**: Introduction, Natural and artificial genetic modification, methodology, application of gene manipulation to aquaculture.

2.2 **Genetic improvement of Pearl Oyster**.

UNIT – 3

3.1 Diseases in hatcheries: Causes, diagnosis, prevention and control.

3.2 Cell Culture and PCR techniques for detecting viral diseases of shrimps.
Introduction to fouling organisms and methods of prevention and recovery

UNIT – 4

4.1 Algal culture as a source of protein.

4.2 Sea weed culture.

4.3 Bioactive compounds from marine organisms.
(Antibacterial compounds, Marine toxins and other marine products)

4.4 Biotechnology and sustainable aquaculture.

4.5 Application of recombinant hormone and growth factors in fish culture.

REFERENCES:

1. M. Fingerman and R. Nagabhusan (2002) Recent advances in Marine Biotechnology (series) Pub. : Science Publishers.
2. M. Fingerman and R. Nagabhusan (2000) Recent advances in Marine Biotechnology (series) Vol - Aquaculture (Sea weeds and invertebrates) Pub. : Science Publishers ISBN 978–1–57808–082–3.
3. R. Nagabhuashan Diwan A. D., Zahurnec B. J. and Sarojini R. (2004).
4. R. C. Ray (2006) Microbial Biotechnology in Agriculture and aquaculture Vol – I & II Pub. : Science Publishers, ISBN 978–1–57808–443–2.
5. Varun Mehta (2006) Fisheries and Aquaculture Biotechnology Pub. : Book International ISBN 81-8030-091-9.

IBT – 803: AGRICULTURE BIOTECHNOLOGY

UNIT – 1

1.1 Somaclonal variation:

1.1.1 Origin of somaclonal variation.

1.1.2 Isolation of somaclonal variation,

1.1.3 Somaclonal varation and induced mutation.

1.1.4 Screening and cell selection.

1.2 Somatic Hybridization:

1.2.1 Protoplast isolation and culturing.

1.2.2 Protoplast fusion

1.2.3 Selection of hybrid cells.

1.2.4 Regeneration of hybrid plants.

1.2.5 Genetic transformation using protoplast.

1.2.6 Applications in plant improvement.

1.2.7 Advantages and disadvantages of somatic hybridization.

UNIT – 2

2.1 Transgenic plants:

2.1.1 Vectors for production of transgenic plants

Plasmid vectors

Plant virus vectors

2.1.2 Transformation techniques

Agro bacterium mediated gene transfer.

Direct gene transfer (PEG mediated, microinjection, particle bombardment, electroporation)

2.1.3 Analysis and confirmation of transgenic integration

UNIT - 3

3.1 Resistance to abiotic and biotic stress:

3.1.1 Herbicide resistance

3.1.2 Insect resistance

3.1.3 Virus resistance

3.1.4 Draught resistance

3.1.5 Fungal and bacterial disease resistance.

UNIT – 4

4.1 Molecular Markers and Marker assisted selection:

4.1.1 Molecular Marker system.
(SCARs, AFLP, ASAP, AS-PCR, Microsatellite repeat polymorphism, RAPD)

4.1.2 Mapping diseases resistance genes.

4.1.3 Mapping Quantitative trait loci (QTLS).

4.1.4 Molecular Breeding and Marker based selection.

4.1.5 Advantages and limitations of molecular markers.

4.2 Molecular Farming:

4.2.1 Definition and histology GMO based pharmaceutical production.

4.2.2 Molecular farming of pharmaceutical proteins, antigens for edible vaccines monoclonal antibodies.

4.2.3 Benefits, risks and environmental impact of GMOs.

REFERENCES:

1. B. D. Singh, Plant Biotechnology, Kalyani Publishers – 2006.
2. A. F. Mascarenhas, Handbook of Plant Tissue Culture, ICAR Publication, New Delhi.
3. U. Kumar, Methods in Plant Tissue Culture – Agrobios-2000.
4. R .Ranajn, Transgenic Plant – Agrobios-2000
5. S. S. Purohit, A Laboratory Manual of Plant Biotechnology – Agrobios-1995.
6. Atul Kumar and Vandana Kumar, Clonal Tissue culture of important frut crops – International Book Distributors.
7. Sanbrook and Russel, Molecular Biologu – A Laboratory Manual Vol. 1,2,3.
8. Atul Kumar and Vandana Kumar, Plant Biotechnology and Tissue Culture Principles and perspectives – International Bok Distributors – 1996.

IBT – 804: IMMUNOTECHNOLOGY AND VIROLOGY

Section I: Virology

UNIT - 1

1.1 Origin of Virological knowledge.

1.2 Major groups of viruses: Bacterial, Animal and Plant.

1.3 Nomenclature and Classification of Viruses.

1.4 General Methodology of Virus Research.

1.5 Titration of Viruses: Bacteriophage assay, Titration of Animal and plant viruses, Loss of infectivity.

1.6 Properties of Virions: Purification, Morphology of virions, Physical-chemical methods in virus research and serological properties.

1.7 Biochemistry of Viruses.

1.8 Subviral agents: Genomes without viruses and viruses without genomes.

UNIT – 2

2.1 Bacterial viruses: T-Even Coliphages, Bacteriophage λ, Phage P_1, P_2 and P_{22}

2.2 Animal viruses: Pox viruses, Retro viruses, Adenoviruses and Herpesviruses.

2.3 Plant viruses transmission by: arthropod vectors, nematodes and fungi.

2.4 Insect pathogenic viruses.

2.5 Tumor viruses.

Section II: Immunotechnology

UNIT – 3

3.1 Hybridoma techniques and monoclonal antibody production:

3.1.1 Myeloma cell lines.

3.1.2 Fusion of myeloma cells with antibody producing B-cells.

3.1.3 Fusion methods.

3.1.4 Selection and screening methods for positive hybrids.

3.1.5 Cloning methods.

3.1.6 Production, Purification and characterization of monoclonal antibodies.

3.1.7 Application of monoclonals in biomedical research, in clinical diagnosis and treatment.

3.1.8 Production of human monoclonal antibodies and their applications.

3.2 Antibody engineering: Antibody gene cloning, Recombinant antibody gene expression, Application of engineered antibodies.

UNIT- 4

4.1 Gene Transfer technology.

4.2 SCID Mice and SCID-human Mice.

4.3 Bone marrow Transplantation.

4.4 Tissue culture: Cell culture, Cell lines and Cell culture techniques.

4.5 Cancer Immunology: Introduction; Malignant transformation of cells; Oncogenes and cancer induction, Tumors of immune system, Tumor antigens, Tumor evasion of the immune system.

REFERENCES:

1. Immunology R.A. Goldsby, T.J. Kindt, B.A. Osborne and J. Kuby; (Fifth Edition) W. H. Freeman and Company.
2 Immunology (6th edition): Roitt, Brostoff and Male.
3. Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman.
4. Basic Immunology: Functions and Disorders of the Immune System by Abul K. Abbas, Andrew H. Lichtman.
5. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988.
6. Medical virology- Morag C and Timbury M.C.(1994)X Edition. Churchill Livingstone, London.
7. Introduction to Modern Virology, Dimmock NJ, Primrose SB (1994). IV Edition, Blackwell Scientific Publications,Oxford.
8. Virology- Conrat HF, Kimball PC and Levy JA(1994), III Edition Prentice Hall, Englewood cliff, New jersey.
9. Text Book on principles of Bacteriology, virology and Immunology, Topley and Wilson's (1995) Edward Arnold, London.
10. The Genetics of Bacteria and their viruses. William Hayes (1985), Blackwell Scientific Publishers, London.
11. General Virology, Third edition, S. E. Luria, James Darnell, Jr., David Baltimore, Allan Campbel, John Wiley Sons.
12. Bacteriophages, Mark H. Adams -inter science publishers, Inc. New York.
13. Basic Virology, Edward K. Wagner, Martinez J Hewlett, David C. Bloom, and David Camerini, Third Edition, Blackwell Publishing.

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PRACTICALS
IBT – 805

BIOPROCESS TECHNOLOGY, IMMUNOTECHNOLOGY & VIROLOGY

Bioprocess Technology:

1. Microbial fermentation of Penicillin

1.1. Determination of optimum pH for production of Penicillin.

1.2. Determination of optimum incubation period for Penicillin production.

1.3. Determination of optimum temperature for Penicillin production.

1.4. Determination of optimum inoculum size for Penicillin production.

2. Microbial fermentation of Citric acid

2.1. Determination of optimum pH for production of Citric acid.

2.2. Determination of optimum incubation period for Citric acid production.

2.3. Determination of optimum temperature for Citric acid production.

2.4. Determination of optimum inoculum size for Citric acid production.

3. Comparative studies of Ethanol production using different substrates.

4. To carry out Solid state fermentation for the cellulase production.

5. To carryout fermentation of vitamin B12 and assessment of its yield by bioassay.

Immunotechnology:

1. Isolation and identification of following medically important bacteria:

- *E. coli*
- *S .typhi, S. paratyphi A, S. paratyphi B*
- *P. aeruginosa*
- *S. aureus*

Virology:

1. Enrichment and isolation of coliphages from sewage sample.

2. Study of one step growth curve of Bacteriophages.

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PRACTICALS
IBT – 806

AGRICULTURE BIOTECHNOLOGY & AQUACULTURE TECHNOLOGY

1. Agriculture Biotechnology:

1.1 Micropropagation.

1.2 Embryo Culture.

1.3 Anther Culture.

1.4 Induction of Somatic Embryos.

1.5 Somatic hybridization.

1.6 Somaclonal variation identification.

1.7 Agrobacterium based genetic transformation.

1.8 Diversity analysis through molecular markers.

2. Aquaculture Technology:

2.1 Algal culture.

2.2 Sea weeds culture.

2.3 Identification of fish scales.

2.4 Identification of commercially available fish of South Gujarat.

2.5 Detection and viral diseases in shrimps with the help of the PCR technique.

2.6 To study the bioactive compounds from algae and marine organisms.

2.7 Field Study: 1. Induced Breeding Prawn/Major carp.
2. Food processing unit (Fish).