

## Semester III

<b>16IMBCC09</b>	<b>Core 7: Aquatic Microbiology</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

This course is designed

- To acquaint the students with the theoretical and practical aspects of the aquatic environment and biodiversity
- To give an overview of microbial interaction in aquatic ecosystem and its importance
- To give an understanding about the fresh water and waste water ecology and role of microbes in waste water treatment.

**UNIT- 1 Aquatic environment** **10hrs**

- Marine and freshwater Environments,
- Physical and Chemical Factors in Aquatic environment,
- Microbial adaptations to aquatic Environments,
- Techniques for the Study of Aquatic Microorganisms

**UNIT-2 Microbes of Aquatic Environment** **10hrs**

- Distribution of Microbes in the Aquatic Environment,
- Freshwater AND Marine water Environment,
- Microbes in marine environments,
- Microbes in Fr
- esh environment

**UNIT-3 Microbial diversity of aquatic ecosystem** **10hrs**

- Ecology of coastal, shallow and deep sea microorganism
- Importance and their significance.
- Diversity of microorganism - Achaea, bacteria, cyanobacteria, algae, fungi, viruses and Actinomycetes in the mangroves and coral environments.

**UNIT-4 Drinking Water Purification** **10hrs**

- Water purification,
- Sanitary qualities:
  - a. Sanitary surveys,
  - b. Bacteriological evidence of pollution,
  - c. Bacteriological techniques,
  - d. Microbes other than coliforms Bacteria

## **UNIT-5 Waste Water**

**10hrs**

- Waste water- Introduction
- Chemical & Microbiological characteristics of waste water,
- Waste water treatment-Processes, microbes & wastewater treatment procedures,
- Efficiency of wastewater treatment procedures

### **Text Books:**

- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing co. Ltd.
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Mc GrawHill publication.
- Powar, C.B., Daginawala, J.F. (1982). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.

### **Reference Book:**

- Carter, R.W.G. (1998). Coastal Environments: An Introduction to the Physical, Ecological and Cultural Systems of Coastlines. London: Academic Press.
- Park, C.C. (1980). Ecology and Environmental Management. London: Butterworths publication.
- Kormondy, E. J. (1986). Concepts of Ecology. New Delhi: Prentice-Hall.

<b>16IMBCC10</b>	<b>Core 8 : Agriculture Microbiology</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

After successfully completing this course the student should be able to:

1. Identify the role of soil in the sustenance of microbial life
2. Understand the characteristics of major groups of microorganisms in soil
3. Explain the fundamentals of various geochemical cycles in the soil and the role of microbes in each
4. Understand the beneficial as well as harmful role of microbes in Agriculture.

**UNIT 1: Soil As A culture media 9hrs**

- Introduction to soil
- Formation of soil- weathering of rocks, pedogenesis
- Soil profile
- Edephic factors-Physical and chemical properties of soil

**UNIT 2: Microbial Interactions in soil 9hrs**

- Rhizosphere
- Microbial diversity of soil
- Microbial Interactions in soil
  1. Microbe – microbe interaction
  2. Plant – microbe interactions

**UNIT 3: Biofertilizers and Biopesticides 12hrs**

- Overview of organic farming
- Biofertilizers
- Biopesticides
- PGPR –Plant growth promoting rhizobacteria
- Introduction to mycorrhiza
- IPM

**UNIT 4: Beneficial role of microbes in Agriculture 10hrs**

- GMO – Definition, history and Current status
- Microbial Techniques in Crop improvement
- Phytoremediation
- Beneficial Sea weeds

**Unit 5: Harmful effect of microbes in Agriculture 10hrs**

- General Mechanism, Propagation and control of:
  - Plant diseases by Bacteria-Xanthomonas citrii
  - Plant diseases by viruses - TMV
  - Plant diseases by fungi – Types and one example of each

- Plant pathogenic Nematods

**Text Books:**

1. Alexander, M. (1985). Introduction to soil Microbiology. New York: John Wiley & Sons.
2. Motsara, M.R. Bhattacharyya, P., Srivastava, B. (1995). Biofertilizer- Technology, Marketing and Usage. New Delhi: Fertilizer Development & Consultant Organization.
3. Rangaswami, G., Bagyaraj, D.J. (1992). Agricultural Microbiology. New Delhi: Asia Publishing House.
4. Subba Rao, N.S. (1999). Biofertilizers in Agriculture and Agroforestry. New Delhi: Oxford & IBH.
5. Subba Rao, N.S. (1995). Soil Microorganisms and Plant Growth. New Delhi: Oxford & IBH.
6. Waiter, M.J., Morgan, N.L., Rocky, J.S., Higton, G. (1999). Industrial Microbiology- An Introduction: Blackwell Scientific Publication

**Reference Books:**

- Dirk, J., Elas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology. New York: Marcel Dekker INC.
- Ramanathan, N., Muthukaruppan, S.M. (2005). Environmental Microbiology. Annamalai Nagar: Om Sakthi Pathipagam.

<b>16IMBCC11</b>	<b>Core 9: Food and Dairy Microbiology</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

This course is designed to provide Instruction about

- General principles of food microbiology and dairy Microbiology.
- Food spoilage by microorganisms;
- The microbiology of food preservation and food commodities;
- Fermented and microbial foods;
- Principles and methods for the microbiological examination of foods; micro biological quality control, and quality schemes.
- Processing in dairy for milk and milk product is core part of dairy microbiology.

**UNIT –1 Introduction to Food Microbiology and Food Preservation 10hrs**

- Microbial flora of fresh food
- Food as a substrate for micro organisms -. Micro organisms important in food microbiology;
- Preservation of foods: General principles & methods of food preservation
- Principles of food preservation - Asepsis - Removal of micro organisms, anaerobic conditions - High temperature - Low temperature - Drying - Food additives

**UNIT –2 Food Spoilage, Food Intoxication and Food borne Infection 10hrs**

- Microbial spoilage of foods: Fresh foods & Canned foods
- Food Spoilage
- Food Borne infection & intoxication
- Role of *S.aureus*, *C.botulinum* & *Salmonella Spp.* in food poisoning – Case Study
- Microbiological examination of food; Introduction to AGMark

**UNIT – 3 – Milk Microbiology 10hrs**

- Milk as a medium, normal flora of milk
- Types of microorganisms in milk: Biochemical types, Pathogenic types, Temperature types
- Spoilage of milk & milk products
- Microbial analysis of milk: SPC, Direct count, MBRT, Resazurin test
- Grading of milk

**UNIT-4 – Dairy Products and Preservation Of Milk 10hrs**

- Fermented milk Beverages
- Manufactured Dairy Products: Starter Culture, Cheese, Yogurt, Buttermilk, Acidophilus milk, Kefir
- Preservation of milk: Principles
- methods of preservation

#### **UNIT –5 Fermented Foods**

**10hrs**

- Fermented Dairy Products.
- Brief introduction about fermented foods: Pickles, Sauerkraut, Silage, Sausages & Bread
- Microorganisms as food: Single Cell Protein, Mushrooms
- Functional foods

#### **Text Books:**

- Frobisher, M. (1974). Fundamentals of Microbiology. 9<sup>th</sup> Edition. Philadelphia, PA: W. B. Saunders Company.
- Frazier, W.C., Westhoff, D.C. (1978). Food Microbiology. Tata McGraw-Hill Publishing Company.
- Swaminathan, M. (1990). Food Science, Chemistry and Experimental Foods. Mysore: Bappco Book Publishing Company.
- Jay, J.J., Loessener, M.J., Golden, D.A. (2005). Modern Food Microbiology: Springer publication.
- Prajapati, J.B. (1995). Fundamentals of Dairy Microbiology: Ekta Publication.

#### **Reference Book:**

- Manay, S., Shadaksharaswami, M. (2008). Foods: Facts and Principles. New Delhi: New Age Publishers.
- Srilakshmi, B. (2002). Food Science. New Delhi: New Age Publishers.
- Meyer, L.H. (2004). Food Chemistry. New Delhi: New Age Publishers.
- Kenneth, F.K., Kriemhild, K.O. (2000). The Cambridge World History of Food. Cambridge: Cambridge University Press.

<b>16IMBCC12</b>	<b>Core Practical – 3- Applied Microbiology</b>	<b>6hrs/wk</b>	<b>3 Credits</b>
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### Course Objectives:

The course will impart

1. Technical skill for enumeration of water, soil, food and milk microbes
  2. Understanding about the role of microbes in agriculture and food
  3. Knowledge about the properties of microbes which make them important in nature .
  4. To develop skills, through lab experiments, in some of the specific methodologies used in the study of modern food and dairy microbiology
  5. An insight into the role of microorganism in waste water treatment
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1. Enumeration of different kinds of microorganisms in soil – qualitative and quantitative methods
  2. Study of degradation of organic matter.
  3. Isolation of rhizosphere microorganisms – Isolation of nitrogen fixing microorganisms. *Rhizobium*, *Azospirillum* and *Azotobacter* -
  4. Isolation of phosphobacteria –
  5. Observation of mycorrhiza roots.
  6. Food spoilage - microorganisms involved in dairy products - Identification of bio control agents.
  7. Isolation and identification of microorganisms involved in food spoilage
  8. Enumeration and identification of food poisoning organisms
  9. Study of food spoilage ( Characters that shows food is spoiled)
  10. Isolation of microorganisms from milk and milk products and their identification • Microbiological grading of milk and milk products
  11. Production and estimation of lactic acid by *Lactobacillus* Sp. Or *Streptococcus* Sp.
  12. Production of fermented milk by *Lactobacillus acidophilus*. - Yogurt
  13. Rapid analytical techniques in food quality control using microbial Biosensors.
  14. Standard qualitative analysis of milk
  15. Methylene Blue Reduction Time test for milk
  16. To preserve food with high salt/vinegar/high sugar for long time
  17. Isolation of probiotics.
  18. Microbial analysis of water by presumptive, confirmed and completed test
  19. Coliform analysis by MPN test
  20. Chemical analysis of water for hardness and chlorine
  21. To estimate Biological oxygen demand
  22. To estimate chemical oxygen demand
  23. To estimate - Nitrate, Nitrite nitrogen in water, phosphate and sulphate in water

### Reference Books:

- Adams M.R., Moss, M.O. (2008). Food Microbiology. 2<sup>nd</sup> Edition: Royal Society of Chemistry.
- Banwart, G.J. (1989). Basic Food Microbiology: Springer publications.
- Doyle, M.P., Buchanan, R.L. (1997). Food Microbiology: Fundamentals and Frontiers: ASM publication.
- Joshi, V.K., Pandey, A. (1999). Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2. Emakulam: Educational Publishers & Distributors.
- Prajapati, J.B. (1995). Fundamentals of Dairy Microbiology: Ekta Publication.
- Garbult, J. (1997). Essentials of Food Microbiology: Hodder Arnold publication.
- Wood, B.J. (2012). Microbiology of Fermented Foods. Volume I and II: Elsevier Applied Science Publication.
- Robinson, R.K. (2002). Dairy Microbiology Handbook: Wiley-Blackwell publication.
- Patel R.K. (2009). Experimental Microbiology. New Delhi: Aditya Book Centre.



<b>16IMBDA05</b>	<b>DSE Allied - 3: Sustainable Management</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

This course is designed to provide Instruction about

- General principles of food microbiology and dairy Microbiology.
- Food spoilage by microorganisms;
- The microbiology of food preservation and food commodities;
- Fermented and microbial foods;
- Principles and methods for the microbiological examination of foods; micro biological quality control, and quality schemes.
- Processing in dairy for milk and milk product is core part of dairy microbiology.

**UNIT –1 Introduction to Sustainable Management**

**10hrs**

- What is Sustainable Management?
- Sustainable development and Green Climate Fund
- Introduction to Corporate Social Responsibility and ISO 14001
- Brief account on SDGs (Sustainable Development Goals), Agenda 21, MDGs (Millennium Development Goals), UNDP

**UNIT –2 Biodiversity and its importance with respect to Environment and Economy**  
**10hrs**

- Basic Concept of Biodiversity – Definition, Types of Biodiversity, Keystone Species, Importance of Biodiversity
- Global Distribution of Biodiversity and Biodiversity Hotspots
- Biodiversity in India – Wetlands, Marine Environment, Endemism, Biodiversity and People’s Livelihood
- Forest Biological Diversity- Status of forest in India, Genetic Diversity of Indian Trees

**UNIT –3 Biodiversity in sustainable Agriculture**

**10hrs**

- Agrobiodiversity and Local Knowledge and its importance
- Plant Agrobiodiversity – Centres and origin, Value of Plant genetic resources
- Animal Genetic Resources – Five Major Species, Species with a Narrower Distribution, Breed Diversity
- Agrobiodiversity and Food Security

**UNIT – 4 Threats to Biodiversity and impact of Biodiversity loss on sustainability  
10hrs**

- Extent of Biodiversity Loss
- Biodiversity Threats
- The Indian Scenario
- Protected Areas and Countering Biodiversity Loss

**UNIT- 5 Sustainable Use of Biodiversity 10hrs**

- Sustainable Use of Biodiversity
- International and National Instruments Relating to Biodiversity Management
- Gender and Biodiversity in India
- Conservation Measures of Biodiversity

**Reference Book:**

- IGNOU Study Materials
- Verma, P.S., Agrawal, V.K. (2005). Ecology, Cell Biology, Molecular Biology, Genetics. New Delhi: S. Chand and Company Limited.

<b>16IMBDA06</b>	<b>DSE Allied – 3 Practical : Sustainable Management</b>	<b>1hrs/wk</b>	<b>No Credit</b>
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These are practice and observation exercises for the better understanding of the basic concepts like:

1. Microscopic Study of water from different sources to compare microbial and other biodiversity
2. Study of Agrodiversity
3. Case Study
4. Group Discussion

## Semester - IV

<b>16IMBCC13</b>	<b>Core 10: Bacterial Metabolism</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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### Course objectives:

After successfully completing this course the student should be able to:

5. Understand the central metabolic reactions in a cell and an organism
6. Understand the mechanism of energy generation and its utilization during cellular activities
7. Explain the fundamentals of catabolism of different biomolecules, its mechanism and its importance
8. Identify the metabolic differences among various categories of bacteria.
9. Understand the process and mechanism of transport of molecules across the membrane for metabolic reactions

### UNIT – 1: Introduction to Metabolism, Bioenergetics and Enzyme Kinetics

#### 10hrs

- General Overview of Metabolism, primary and Secondary Metabolism and their significance
- Thermodynamics –First law of thermodynamics, second law of thermodynamics
- Bioenergetics: The concept of free energy, Determination of  $\Delta G$  & Energy rich compounds
- Energy metabolism: Introduction to metabolism, Role of ATP in metabolism, Role of reducing power in metabolism, Role of precursor metabolites in metabolism
- Kinetics of a single-substrate enzyme catalysed reaction, Michaelis-Menten Equation,  $K_m$ ,  $V_{max}$ , L.B. Plot, Turnover number,  $K_{cat}$ ; Kinetics of Enzyme Inhibition; Kinetics Allosteric enzymes

### UNIT – 2: Catabolism of Carbohydrates

#### 10hrs

- General overview of various metabolic pathways, regulations and their significance
- Glycolysis and its regulation
- Pentose phosphate pathway
- Entner-Doudrroff pathway
- Citric acid cycle and its regulation
- Glyoxylate cycle

### UNIT – 3: Metabolism of amino acids, Nucleic acids and Lipids

#### 10hrs

- Biodegradation of amino acids – deamination, transamination, decarboxylation; Stickland Reactions
- Urea cycle including its regulation
- Biosynthesis of amino acids
- Biologically active amines Recycling of Purine and Pyrimidine nucleotides by salvage pathways
- Oxidation of Fatty Acids, Beta-Oxidation of Fatty Acids

#### **UNIT – 4: Bioenergetics and Membrane Transport**

**10hrs**

##### **Bioenergetics:**

- Different modes of ATP generation and comparative study of ATP (energy budget)
- Electron transport chain: Introduction, Components of ETC and energy yield
- Anaerobic Respiration
- Methods of studying biosynthesis: Strategy of Biosynthesis, Use of Biochemical Mutants, Use of Isotopic Labelling
- Bacterial photosynthesis; Biosynthesis of peptidoglycan

##### **Membrane Transport:**

- Transport of small molecules across membrane: Active and Passive transport
- Specific Transport Systems: Mechanosensitive channels, ATP-binding cassette Transport family, Chemiosmotic-driven transport, Establishing Ion gradients, Iron transport
- The phosphotransferase system
- Quorum sensing

#### **UNIT – 5: Some selected aspects of metabolism in specific microbial systems**

**10hrs**

- Chemo-autotrophs: Nitrifying Bacteria, Sulfur Oxidizers, The Iron bacteria, The Hydrogen bacteria
- The lactic acid bacteria: Patterns of carbohydrate fermentation in lactic acid bacteria
- The Enteric group and related Eubacteria: Fermentative patterns of Gram negative Eubacteria
- Archaeobacteria: Energy metabolism and Carbon - Assimilation in Methanogens, photophosphorylation in *Halobacterium*

##### **Text Books:**

- White, D. (2000). The physiology and Biochemistry of Prokaryotes, 2nd edition: Oxford University Press.
- Conn E.E., Stump P.K. (1989). Outlines of Biochemistry. Wiley publication.

- Stanier, R.Y. (1987). General Microbiology, 5<sup>th</sup> Edition: Macmillan publication.
- Nelson, D.L., Cox, M.M. (2013). Lehninger Principles of Biochemistry. W.H. Freeman publication.
- Moat, A.G., Foster. J.W., Spector, M.P. (2009). Microbial Physiology, 4th Ed: Wiley India Pvt Ltd.

**Reference Books:**

- Dirk, J., Elas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology. New York: Marcel Dekker INC.
- Ramanathan, N., Muthukaruppan, S.M. (2005). Environmental Microbiology. Annamalai Nagar: Om Sakthi Pathipagam.

<b>16IMBCC14</b>	<b>Core 11: Analytical Techniques</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

After successfully completing this course the student should be able to:

1. Understand the working principle and application of various analytical techniques in the field of Bioscience
2. To comprehend theories and principles of various Chromatographic techniques
3. Understand General principles and applications of electrophoresis and Centrifugation techniques
4. Identify the role and the application of various molecular biology techniques in the field of Microbiology

**UNIT 1 Basic Analytical Technique in Biosciences**

**10hrs**

- Colorimetry and Spectrophotometry
- Introduction to Flame Photometry and its applications
- Applications of Radioisotopes in biosciences
- Atomic spectroscopy: Principles and application of Atomic Absorption/Emission Spectrometer
- Microtomy – sectioning.

**UNIT 2 Chromatography**

**10hrs**

- Chromatography : Theories and Principles
- Paper and Thin layer Chromatography
- Affinity and Ion Exchange Chromatography
- Partition and Size Exclusion Chromatography
- Gas Chromatography and High Performance Liquid Chromatography, HPTLC

**UNIT 3 Electrophoresis**

**10hrs**

- Electrophoresis : General principles, Horizontal & Vertical Gel electrophoresis, Isoelectric focusing
- Paper Electrophoresis
- Gel Electrophoresis : PAGE and AGE and PFGE, Capillary Electrophoresis
- Immunoelectrophoresis. Immunoblotting.

**UNIT 4 Centrifugation**

**10hrs**

- Centrifugation techniques- Basic principles,
- Different types of centrifuges, Analytical and Preparative
- Ultracentrifugation methods.
- Density gradient centrifugation.

## **UNIT 5 Molecular Biology Techniques**

**10hrs**

- DNA sequencing: Principles and Methods, Automated DNA sequence Analyzer
- Blotting techniques and FISH
- RFLP, RAPD, VNTR, STR and SNP analysis, ARDRA
- Chemical synthesis of DNA
- PCR Technology: Principle, Methods and Applications
- Introduction to Biosensor Technology

### **Text Books:**

- Purohit, S.S. (2007). Microbiology-Fundamentals and Applications, 6<sup>th</sup> Edition. New Delhi: Agrobios Publications.
- Wilson, K., Walker, J. (2010). Practical Biochemistry – Principle and Technique, 7<sup>th</sup> Edition. Cambridge: Cambridge University Press.
- Attwood, T.K., Parry. D.J. (1999). Introduction to Bioinformatics: Longman publication

### **Reference Books:**

- Westhead D.R., Parish J.H., Twyman, R.A. (2002). Instant notes in Bioinformatics. Taylor and Francis publications.
- Andreas, D. B., Ouellette, B.F.F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition: Wiley publication.
- Chatwal R.G., Anand, S.K. (2012). Instrumental Methods of Chemical Analysis. Mumbai: Himalaya publication.
- Freifelder, D. (1982). Physical Biochemistry: Application to Biochemistry and Molecular biology, 2nd edition. San Francisco: W.H. Freeman and company.
- Sadashivam, S., Manickam, A. (2004). Biochemical methods, 2nd edition. New Delhi: New Age International (P) Limited.
- Upadhyay, A., Upadhyay, K., Nath, N. (2009). Biophysical Chemistry: Principles and techniques. Mumbai: Himalaya publication.
- Oser, B.L. (2006). Hawk's physiological chemistry. 14th Ed. New York, NY: McGraw-Hill Book Company.
- Boyer, R.F. (2002). Modern Experimental Biochemistry. San Francisco: Benjamin Cummings Publ. Company.

- Williams, B.D., Wilson, K. (1981). A Biologist's Guide to Principles and Techniques of Practical Biochemistry. London: Edward Arnold publications.

<b>16IMBCC15</b>	<b>Core 12: Industrial Microbiology</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

The course is designed to provide to the students:

1. Knowledge of basic principle of fermentation process,
2. Insight in helping students to design, develop and operate industrial level fermentation process.
3. This fundamental knowledge is essential for the students to make their career in industry based on bioprocess.

**UNIT – 1: Fermentation Technology & Industrially Important Microorganisms  
10hrs**

- Basic concept: Industrial Microbiology
- Range of Fermentation Processes; Component parts a fermentation process
- Fermentation Economics; GLP and GMP
- Screening of industrially important microorganisms: Use of enrichment techniques in isolation methods; Primary & Secondary Screening; Culture Collection Centres in India and abroad
- Improvement of industrially important microbes: Application of Mutation, protoplast fusion and recombinant DNA technology

**UNIT – 2: Formulation of Fermentation Media  
10hrs**

- Introduction, Types of Media and Medium formulation
- Raw materials: Crude Carbon and Nitrogen sources
- Minerals, Precursors, Growth Regulators, Buffers, Antifoam agents
- Media Optimization
- Inoculum Medium

**UNIT – 3: Design and aseptic operation  
10hrs**

- Introduction and basic functions of fermenter
- Types of bioreactors: Continuous stirred tank bioreactor, air lift fermenter, tower fermenter, immobilized enzyme bioreactors
- Aeration and Agitation
- Fermentation process: Batch Fermentation, Continuous fermentation and their comparative advantages and disadvantages
- Sterilization process in fermentation industries: Fermentor sterilization; Medium sterilization; Sterilization of air and feed
- Aseptic operation and Containment



#### **UNIT – 4: Overview of Downstream Processes**

**10hrs**

- Methods of Cell separation: Broth conditioning, Precipitation, Sedimentation, Centrifugation, Filtration
- Techniques of Cell Disruption: Mechanical and Non mechanical methods
- Product Recovery: Liquid-Liquid extraction, Solvent recovery, Two Phase aqueous extraction, Super critical fluid extraction; Chromatography, Drying and crystallization
- Physical, Chemical and Biological assay of fermentation products

#### **UNIT – 5: Studies of selective fermentation processes**

**10hrs**

- Production of organic solvents: Ethyl alcohol
- Production of enzymes: Amylases and Proteases
- Production of antibiotics: Penicillin
- Production of amino acids: Lysine
- Production of organic acids: Citric acid
- Production of vitamins: Riboflavin
- Introduction to methods to immobilize whole cell and/ or enzymes; Applications

#### **Text books:**

- Stanbury, P.F., Whittaker, A. (1984). Principles of Fermentation Technology, 2<sup>nd</sup> Edition. Pergamon Press.
- Casida, L.E. (1968). Industrial Microbiology. New Delhi: New Age International Pub. (P) Limited.

#### **Reference Books:**

- Crueger, W., Crueger, A. (1990). A text book of Industrial Microbiology, 2<sup>nd</sup> edition: Sunderland, Mass.: Sinauer Associates.
- Patel, A.H. (2011). Industrial Microbiology, 2<sup>nd</sup> Edition: Laxmi publication.
- Joshi, V.K., Pandey, A. (1999). Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2. Emakulam: Educational Publishers & Distributors.
- Prescott, S.C., Dunn, C.G., Reed, G. (1982). Prescott & Dunn's Industrial Microbiology. Westport: AVI Publication.

<b>16IMBDA07</b>	<b>DSE – Allied – 4 – Biostatistics and Bioinformatics</b>	<b>4hrs/wk</b>	<b>4 Credits</b>
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**Course objectives:**

The goal for the Biostatistics and Bioinformatics for Basic Scientists course is to

1. Provide an introduction to statistics and informatics methods for the analysis of data generated in biomedical research.
2. Teach through Practical examples covering both small-scale lab experiments and highthroughput assays.
3. Emphasis on the basic concepts of biostatistics and bioinformatics

**UNIT 1 Introduction to Biostatistics**

**10hrs**

- Data Collection and presentation
- Origin of the word, Applications of biostatistics
- Sampling methods, Random and non random sampling
- Graphical presentation of data

**UNIT 2 Measures Of Biostatistics, Probability Distributions**

**10hrs**

- Measures of central tendency Mean, median and mode
- Measures of dispersion- Range, mean deviation, standard deviation, variance
- Laws of probability
- Normal distribution, Binomial distribution, Poisson distribution

**UNIT 3 Hypothesis Testing, Correlation and Regression Analysis**

**10hrs**

- Types of hypothesis
- Tests of significance-student's t test, F test
- Chi-square test, ANOVA test
- Types of correlation
- Methods to study correlation analysis
- Methods of regression analysis

**UNIT 4 Computer Science**

**10hrs**

- Structure of computer: Components, peripherals, uses and types
- The window screen and parts of window, the control panel
- MS Office: MS word, MS power point, MS Excel
- Internet: History, Basic Concepts, Connection Types, Applications, Search Engines and

E mail

- Basics of HTML, page creation and design using HTML
- Multimedia Usage

### **UNIT 5 Bioinformatics**

**10hrs**

- Introduction and importance of Bioinformatics
- Database and DBMS : Introduction, File formats,
- Primary and Secondary Biological databases, Structure databases, Miscellaneous databases.
- Information retrieval from Biological database : ENTREZ, SRS and DBGET
- Sequence Alignment : Gap penalties, BLAST and FASTA
- Introduction to OMICS technology
- Introduction to Drug discovery and Chemi informatics

### **Reference Books:**

- Andreas, D. B., Ouellette, B.F.F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition: Wiley publication.
- Misener, S. (2000). Bioinformatics – Methods and Protocols: Humana Press.
- Attwood, T.K., Parry. D.J. (1999). Introduction to Bioinformatics: Longman publication
- Westhead D.R., Parish J.H., Twyman, R.A. (2002). Instant notes in Bioinformatics. Taylor and Francis publications.
- Satyanarayan, U. (2008). Biotechnology. Kolkata, West Bengal: Books and allied (P) Ltd.

<b>16IMBCC16</b>	<b>Core Practical - 4: Metabolic analysis and Fermentation</b>	<b>6hrs/wk</b>	<b>3 Credits</b>
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**Course objectives:**

The course will impart

6. Technical skill to the students perform various analytical methods for estimations
  7. Hands on training on many sophisticated instruments
  8. Understanding of upstream and down stream process in the fermentation process
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1. Estimation of Protein by Bradford method
  2. Circular paper Chromatography of Amino acids
  3. Ascending paper chromatography of sugars
  4. Thin Layer Chromatography of Amino acids
  5. Agarose Gel Electrophoresis of DNA
  6. SDS PAGE of Protein
  7. Centrifugation techniques
  8. Microtome usage, sectioning and staining
  9. Primary screening of industrially important microorganisms capable of producing: Antibiotics, Organic acids, amylases
  10. Bioassay of penicillin using *B. subtilis*
  11. Laboratory fermentation of Ethyl Alcohol by *Saccharomyces cerevisiae* & its estimation
  12. Laboratory fermentation of amylase by *B. subtilis* & its estimation
  13. Sterility testing of fermentation products (Demo) – Use of Sterile products for testing Microbial contamination
  14. Immobilization of yeast cells by Ca-alginate entrapment method & determination of viability of immobilized cells by invertase activity / Gluconic acid formation. (Demo)

**Reference books for practical**

- Chappuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4<sup>th</sup> edition: Benjamin Cummings publications.
- Baker, F.J., Breach, M.R. (1967). Handbook of Bacteriological Technique: Butterworth & Co Publishers Ltd.

**Reference Books:**

- Jayaraman, J. (1981). Laboratory Manual in Biochemistry: Wiley publication.
- Sawhney S.K., Singh, R. (2005). Introductory Practical Biochemistry: Alpha Science International.

- Chappuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4<sup>th</sup> edition: Benjamin Cummings publications.

<b>16UMBDA08</b>	<b>DSE - Allied Practical - 4: Biostatistics and Bioinformatics</b>	<b>2hrs/wk</b>	<b>1 Credits</b>
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**Course Objectives:**

The course is designed to

1. Understand mathematic/physical principles of information retrieving and analyzing
2. build up the experience of utilizing website-based softwares and database
3. awareness about the accuracy, limitation and boundary of theoretical methods
4. develop the ability to perform basic computer programming

1. Review of NCBI Portal
2. Review of Biological Data Bases
3. Demonstration on BLAST analysis
4. Comparison of Entrez, SRS, and DBGET retrieval
5. Basic use of Computer – Use of Excel, Power point and Internet
6. Mean, Median, Mode
7. Standard deviation
8. Student t-Test
9. Chi – square Test
10. ANOVA

**Reference Books:**

- Andreas, D. B., Ouellette, B.F.F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition: Wiley publication.
- Misener, S. (2000). Bioinformatics – Methods and Protocols: Humana Press.
- Rao, C.R. (1973). Linear Statistical Inference and its Applications. New York: Wiley publication.