University of Lakki Marwat

Department of Zoology

Semester 8th

S. No	Course Category	Course Title	Credits
1	Major	Bioinformatics	3 (1+2)
2	Major	General Microbiology	4 (3+1)
3	Major	Immunology	4 (3+1)
4	Elective I	Parasitology II	4 (3+1)
5	Elective II	Aquaculture and Fisheries	3 (2+1)
		Total Credits	**18**

Bioinformatics 3 (1+2)

Course Objectives

The course will provide:

1. An introduction to bioinformatics.
2. To develop awareness about fundamental bioinformatics databases.
3. Information on the tools used to compute solutions to those problems, and the theory upon which those tools are based.

Course Outcomes:

Upon successful completion of the course, the students should be able to:

1. **GAIN** an understanding of the basic concepts of Bioinformatics.
2. **EXPLAIN** the basics of bioinformatics and computational biology.
3. To **USE** bioinformatics search tools on the internet for mining data, pairwise and multiple sequence alignments and predict protein structures.

Course Contents:

1. Introduction:

a. Introduction to Bioinformatics, Scope of bioinformatics, useful websites.

b. Aims of bioinformatics, disciplines related to bioinformatics, major tasks involved in bioinformatics analysis, bioinformatics tools

c. Short introduction to proteomics and genomics, and the role of bioinformatics in the pharmaceutical industry.

d. Human genome project

2. Biological databases

a. Data and types of data, data acquisition

b. Major DNA databases around the world, NCBI, BOLD, DDBJ and EMBL

c. Major protein databases in the world, protein sequence databases, protein structure databases

d. Specialized databases, genome and organism databases

e. Non sequence databases, pubmed, pubmed health, OMIM

3. Short introduction to DNA/RNA: structure, genetic code; analyzing the DNA/RNA sequence by the use of BI tools.

4. Enzyme classification: retrieval databases

5. Genome mapping

a. Genetic and linkage mapping, physical mapping

6. Gene family:

a. Introduction, types, protein family, Globin family as an example, globin genes and chains, evolution of globin proteins in human, combination and types of globin proteins in human.

7. Data Retrieval:

a. Searching sequence databases

b. FASTA format

c. Retrieval of nucleotide sequence data, retrieval of protein sequence and structure data, retrieval of literature and map data

8. Primer Designing:

a. Primer and probe, qualities of primer, general rules for primer designing.

b. Websites used for primer designing (PRIMER3+, PRIMER-BLAST, OLIGO-CALC etc.)

9. Sequence Alignment:

a. Importance and significance of alignment, methods for sequence alignment

b. Local and global alignment, pair-wise local alignment

10. BLAST: Introduction, types, uses, algorithm, BLAST Scores

11. Multiple Sequence Alignment:

a. Introduction, tools for MSA, uses and importance

12. Phylogenetic analysis:

a. Introduction, interpretation, rooted and unrooted tree,

b. phylogenetic methods, tree terminology, comparison of methods, software

Practicals/Tutorials:

1. Introduction to NCBI
2. Retrieving Literature from NCBI
3. Classification of an organism using NCBI
4. Retrieving FASTA sequence for nucleotide and protein
5. Retrieving disease gene information
6. Searching gene families
7. Primer Designing
8. BLASTing a nucleotide / amino acid sequence
9. Multiple Sequence Alignment using different amino acids / nucleotide sequences
10. Phylogenetic Analysis of different nucleotide / amino acid sequences
11. Microarrays data retrieval from the web

Text and Reference Books:

1. Baxevanis, A.D., Ouellette, B.F.F. (2011) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley & sons, Inc.

2. Rastogi, S.C., Mendiratta, N., Rastogi, P. (2011) Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. PHI publishing.

3. Pevsner, J. (2015) Bioinformatics and Functional Genomics. 3rd Edition. Willey-Blackwell

4. Lesk, A. (2014) Introduction to Bioinformatics. 4th Edition. Oxford University Press

5. Selzer, P., Marhofer, R. and Rohwer, A. (2008) Applied Bioinformatics: An Introduction. Springer publishing, Germany.

6. Primerose, S.B. (2004) Genomics: Applications in Human Biology. Willey-Blackwell
7. Westhead, D.R., Parish, J.H., Twyman, R.M. (2003) Instant Notes on Bioinformatics. Viva Books Private Limited.
8. Krane, D.E. and Raymer, M.L. (2002) Fundamental Concepts of Bioinformatics. Benjamin Cummings.
9. Gibas, C. and Jambeck, P. (2001) Developing Bioinformatics Computer Skills. O'Reilly publishers.

General Microbiology 3 (2+1)

Objectives

The course aims to:

- Enable the students to work with microorganisms.
- Understand the basic techniques of sterilization, culturing, isolation
- Determine different characteristics of the microorganisms

Course Contents

The beginnings of Microbiology: Discovery of the microbial world; Discovery of the role of microorganisms in transformation of organic matter, in the causation of diseases, development of pure culture methods. The scope of microbiology. Microbial evolution, systematics and taxonomy; Characterization and identification of microorganisms. Nomenclature and Bergey's manual.

Viruses: Bacteriophages and phages of other protests. Replication of bacteriophages. Viruses of animals and plants; History, structure and composition; classification and cultivation of animal viruses.Effects of virus infection on cells. Cancer and viruses.

Morphology and fine structure of bacteria: Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths, Prosthecae and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, protoplasts, spheroplasts, the cytoplasm, nuclear material.

The Cultivation of Bacteria: Nutritional requirements, nutritional types of bacteria, bacteriological media, physical conditions required for growth, choice of media, conditions of incubation.

Reproduction and growth of bacteria: Modes of cell division, New cell formation, Normal growth cycle of bacteria, synchronous growth, continuous culture, quantitative measurement of bacterial growth; Direct microscopic count, Electronic enumeration of cell numbers, the plate count method, Membrane-filter count, Turbidimetric method, Determination of nitrogen content, Determination of the dry weight of cells, The selection of a procedure to measure growth, Importance of measurement of growth.

Pure cultures and cultural characteristics: Natural microbial populations selective methods; Chemical methods, Physical methods, Biological methods, Selection in nature, Pure cultures; Methods of isolating pure cultures, Maintenance and preservation of pure cultures, Culture collections, Cultural characteristics; Colony characteristics, Characteristics of broth cultures.

Eukaryotic Microorganisms: Algae: Biological and economic importance of algae; Characteristics of algae; Lichens. Fungi: Importance of fungi; Morphology; Physiology and reproduction, Cultivation of fungi. Economic importance of protozoa.

Prokaryotic diversity Bacteria: Purple and green bacteria; cyanobacteria, prochlorophytes, chemolithotrophs, methanotrophs and methylotrophs, sulfate and sulfur-reducing bacteria, homoacetogenic bacteria, Budding and appendaged bacteria, spirilla, spirochetes, Gliding bacteria, Sheathed bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic

acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria, Endospore forming Gram-positive rods and cocci, Mycoplasmas, High GC Gram-positive bacteria; Actinomycetes, Coryneform bacteria, propionic acid bacteria, Mycobacterium, Filamentous Actinomycetes.

Prokaryotic Diversity: Archaea: Extremely Halophilic archaea, Methane producing archaea: Methanogens, Hyperthermophilic archaea, Thermoplasma.

Practicals

1. Preparation of culture media
2. Pure culturing and cultivation of bacteria
3. Simple, Gram, endospore, capsular, flagellar and acid fast stainings

of different genera of bacteria\Vital staning and microscopic

observations of protozoa

4. Cultivation methods of fungi
5. Isolation of bacteriophages

Books Recommended

1. Eugene W. N., Denise, G., Anderson, M. T., Nester, C., Roberts, E. Nancy, N. 2001. Microbiology: A Hhuman Perspective, McGraw Hill Higher Education.

2. Jacquelyn, G.G. 2001. Microbiology: Principles and Explorations, John Wiley & Sons Inc.

3. Madigan, M.T., Martinko, J.M. and Parker, J. 1997. Brock Biology of Microrganisms, Prentice-Hall, London.

4. Benson, H.J. 1994. MICROBIAL APPLICATIONS: LABORATORY MANUAL IN GENERAL MICROBIOLOGY, WMC Brown Publishers, England.

Immunology 4 (3+1)

Course Objectives:

The objectives of the course are:-

1. To be able to clearly state the role of the immune system and a foundation in immunological processes
2. To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology
3. The students will be able to describe immunological response and how it is triggered and regulated.

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Explore the basic knowledge of immune system

2. Describe the concepts of how the immune system works.

3. Interpret the problems using immunological techniques for diagnosis of immune disorders.

4. Identify the problems usingimmunological diagnostic tools.

5. Detect the problems using the same techniques for other disorders.

6. DEMONSTRATE individually the ELISA and other Assays/Tests.

Course Outline:

1. Introduction

a. Introduction to immunity.
b. Immune response
c. Infectious agents

2. Innate Immunity and Inflammation

a. Sentinel cells and circulating leukocytes
b. Inflammatory events and signalling
c. The formation of pus

3. Microbial Recognition and Responses in Innate Immunity

a. Pattern recognition receptors
b. Innate immune signalling
c. The complement system

4. Antibodies

a. B lymphocytes
b. Antibody structure and function

5. Lymphocyte Development and Diversity

a. Lymphocyte development
b. Clonal selection and expansion
c. Differences between B and T lymphocytes
d. The generation of lymphocyte receptor diversity

6. T Cell Activation by Antigens

a. The role of dendritic cells
b. The lymphatic system and delivery of antigen to lymph nodes
c. Adaptive immune activation in secondary lymphoid tissues
d. Antigen presentation

7. T Cell-Dependent B Cell Responses

a. T Cell activation of B cells
b. Isotype switching and affinity maturation

8. Helper T Cells

a. Helper T cell functions
b. The role of helper T cells in disease

9. Cytotoxic T Cells

a. Cytotoxic T cell functions
b. Selection and expansion of cytotoxic T cells
c. Therapies that target cytotoxic T cell functions

10.Failures of the Immune System

a. Immunodeficiencies
b. Autoimmune diseases
c. Allergic diseases

11. Immunology-Based Therapy of Diseases

a. Transplantation and transfusion

Practical:

1. Antibody Purification and Conjugation
2. Immunofluorescence
3. Gel Techniques
4. ELISA
5. SDS PAGE/Western blots.

Text and Reference Books:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell (5th ed. 2008, Garland)
2. Thomas J Kindt, Richard A Goldsby, Barbara A Osborne, Janis Kuby: Immunology (2003, Freeman). 3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt Roitt: Roitt's Essential Immunology (12th ed. 2012, Blackwell)
3. Abul Abbas , Andrew H. Lichtman, Shiv Pillai. Cellular and Molecular Immunology , 9th edition, 2017. Elsevier Pub Co.
4. Gerd R. Burmester, Antonio Pezzutto Color Atlas of Immunology, 2006. Thieme Stuttgart, New York.

Parasitology-II 4 (3+1)

Theory:

Systematics, biology, pathology, host parasite relationships and control of parasitic Helminths with particular reference to Helminths of Medical and Veterinary importance. Systematics, morphology and biology of Arthropods causing disease or those responsible for transmission of disease. Chemical and non-chemical control of Arthropods of Medical and Veterinary importance.

Helminthology

a. Helminth parasites of man and other animals
b. General account, classification, biology, life cycle, pathology and symptology and immunology of Platyhelmenthes: e.g. Trematodes (Fisccciola and Schistosoma) Cestodes: Taenia. Nematodes: Trichuris, Strongyloides, Toxocara and Filaria worms.

Medical and Veterinary Entomology

a. Biology and classification of arthropods of veterinary and medical importance.
b. Biology and life cycles e.g. lice, Ticks, mites, mosquitoes, fleas, flies, bugs etc.
c. Arthropods as disease transmitters/vectors.

Practical

1. Methods of collection, preservation and transportation of parasitic material.
2. Qualitative and quantitative faecal examination for helminthic ova.
3. Collection, preservation and preparation of slides of local helminthes and their identification.
4. Identification of insects of medical and veterinary importance.

Books Recommended:

1. Noble and Noble, 1982. Parasitology. The Biology of animal parasites. 5th Ed.. Lea and Febiger.
2. Beck, J.W. and Davies, J.E., 1981. Medical parasitology. 3'd Ed.. The C.V. Mosby Company, Toronto, London. Cheesbrough, M., 1987.
3. Medical Laboratory Manual for Tropical Medicine. Vol.I. University Press Cambridge. Smyth, J.D., 1994.
4. Introduction to Animal Parasitology. Cambridge University Press.

Aquaculture and Fisheries 3 (2+1)

Course Objectives:

The course aims to-

1. Impart knowledge about history, needs and importance of fisheries and Aquaculture.
2. Describe the cultureable fish species and their biology.
3. Elaborate the basics of fish culture and aquaculture facilities.
4. Provide knowledge about fishing gears and post-harvest techniques.

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Acquire knowledge about history, needs and importance of fisheries and aquaculture.
2. Discuss various fish species characteristics and understand their culture requirements.
3. Understand basics of pond fish culture and other advanced culture practices.
4. Define various types of fishing gears, capturing methods and post-harvest technology.

Course Outlines:

a. Introduction to fisheries and aquaculture, national and international trends. Fish morphology and diversity in size and shape. Distribution of fishes in Pakistan, commercial fishes, marine and freshwater.

b. Types of ponds, planning construction and pond preparation. Pond fertilization, dosage and methods of application.

c. Food and feeding habits of fishes, feed types, artificial and natural fish feeds, feeding strategies of artificial fish feeds.

d. Aquatic habitats, ecology and extant of distribution, Water quality parameters (abiotic: temperature, light, salinity, pH, turbidity etc.) and their effects on fish health and production.

e. Biotic parameters (plankton, insects, aquatic vegetation etc.) of ponds, lakes, rivers, and impacts on fish growth.

f. Induced breeding techniques.

g. Fish diseases and their control.

h. Fishing gears, fishing techniques, fishing communities.

i. Fisheries co-management.

j. Fish preservation, processing, transportation and marketing.

Practical:

Morphological characters of a typical fish

1. Identification of commercially important fish species, meristic counts, fin formula, scale formula etc.
2. Dissection of common fish to study its various systems.
3. Practical demonstration of induced fish breeding.
4. Introduction to artificial feed ingredients.
5. Fish disease diagnosis and identification.
6. Demonstration of fishing gears and methods of fish capture.

Books Recommended:

1. Fitzsimmons, K., R.S.N. Janjua and M. Ashraf, 2015. Aquaculture Handbook—Fish Farming and Nutrition in Pakistan.
2. Sharma, O. P. 2009. Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur, New Delhi, India.
3. Stickney, R. R. 2009. Aquaculture: An Introductory Text. CABI Publishing, London, UK.
4. Pillay, T.V.R. and M.N. Kutty 2005. Aquaculture: Principles and Practices. Blackwell Science Limited. New York.
5. Ali, S.S. 1999. An Introduction to Freshwater Fishery Biology. University Grants Commission, H-9 Islamabad.