

**SEMESTER IV**

<b>S.No</b>	<b>SUBJECT NAME</b>	<b>L</b>	<b>P</b>	<b>M</b>
<b>THEORY</b>				
01	Molecular Biology	4	0	100
02	Molecular Interactions of Biomolecules	4	0	100
03	Object Oriented Programming in C++	4	0	100
04	RDBMS and HTML	4	0	100
05	Applied Bio Techniques	4	0	100
06	Microbiology	4	0	100
<b>PRACTICALS</b>				
01	Microbiology Lab	0	3	100
02	Object Oriented Programming Lab	0	3	100

## MOLECULAR BIOLOGY

### **Unit 1: Prokaryotic & Eukaryotic Genomes: -**

**9 hours**

Structure & properties of nucleic acids; Models of DNA & RNA structures  
Physical, chemical, spectroscopic nuclear and organelle genomes. Chromosome organization: Histones, Non- Histones, nucleosomes, chromatin structure in Prokaryotes and eukaryotes. Anatomy of eukaryotic genome: eukaryotic nuclear genomes, packaging of DNA into chromosomes. Unusual chromosomes types, pseudo genes and other gene relies.

### **Unit 2: Replication: -**

**9 hours**

General features: replication in prokaryotes-E Coli and phages, Replication in eukaryotes – the issue relevant phages, replication, variations in semi conservative theme, Replication process, initiation- termination, Diverse of topoisomerase. Regulation of Eukaryotic genome replication.

### **Unit 3: Transcription: -**

**9 hours**

Eukaryotic & prokaryotic transcription and RNA processing; structure and function of RNA polymerase and their sub units- POL 1, POL 2, and POL 3. Transcription general features, factors, and DNA binding protein. Post transcriptional modification of RNA; RNA content of cell, precursor RNA, coding, non- coding RNA, transport of RNA, synthesis and processing of non-coding RNA, intorns in eukaryotic pre-rRNA and pre-tRNA. Processing of pre RNA by chemical modification, RNA editing, turnovers of mRNA, mRNA stability, poly adenylation, splicing of nuclear rRNA, nuclear mRNA, organelle RNA and tRNA; Role of maturases; RNA as catalyst – new age of RNA. Transport in mitochondria and chloroplast.

### **Unit 4: Translation: -**

**9 hours**

Synthesis and processing of the proteome; role of t RNA in protein synthesis, amino acylation, and codon – anti codon interaction, The genetic code origin and evolution; Regulation of translation, post translational processes. [Ribosome structure, ribosomal frame shifting, protein folding translation in archea] processing by proteolytic cleavage processing by chemical modification, protein turnover, degradation of ubiquitin- tagged protein in proteasome.

## **Unit 5: Gene Expression and Regulation:**

**9 hours**

General aspect of regulation in prokaryotes and eukaryotes; the operon model- lac, trp operon; DNA methylation; Expression of gene. Regulation of genome activity, signal transmission by import of intracellular signaling compound, signal transmission mediated by cell- surface receptor, second messengers, genome regulation by feedback loops, regulation of genome activity during development and importance of introns – satellite DNA.

### **Prescribed Books:**

- 1) Molecular biology by Robert F. Weaver
- 2) Molecular Cell Biology -by Harvey Lodish - 2000  
-Cytology; Molecular biology; Cells; Molecular Biology; Celbiologie;  
Moleculaire biologie
- 3) Protocols in Molecular Biology: A Compendium of Methods from Current  
Protocols in Molecular Biology by Frederick M Ausubel – 1995

### **Reference Books:**

- 1) Molecular biology (Technique); Molecular biology; Molecular Biology  
(methods);  
Biologia Molecular E Macromolecular; Molecular biology (Molecular  
biology )
- 2) Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian  
Lewis, Martin Raff, Keith Roberts, Peter ... - 2002
- 3) Cytology; Molecular biology by Robert F. Weaver – 2007

### **Web Reference:**

1. <http://www.rothamsted.ac.uk/notebook/courses/guide/>
2. <http://www.topix.com/science/molecular-biology>
3. [http://www.sciencedaily.com/news/plants\\_animals/molecular\\_biology/](http://www.sciencedaily.com/news/plants_animals/molecular_biology/)

## MICROBIOLOGY

### **Unit 1: Introduction to Microbiology:-**

Scope- History- Characterization- Classification; Prokaryotic bacterial cell – size – shape& arrangement; structure, function & cellular composition- Bacteria, fungi, algae, Protozoa & virus ; growth & nutrition, media culture, Cell sorting.

### **Unit 2: Classification, Isolation & methods of microorganisms Identification:-**

Classification for bacteria (Benther& Hooks), bacterial counting, Enumeration of bacteria, culture - media -Isolation, purification, culture maintenance & preservation;

Viruses: classification- DNA, RNA, Herps, AIDS, Retroviruses; Fungi, Algae and protozoa.

### **Unit 3: Microorganisms as recombinants and plasmids in pathogenic diseases:**

Lytic and Lysogenic cycle -pathogenic diseases -testing of bacteria gram stain, biochemical parameter

### **Unit 4: Microorganisms in Ecosystem and Industrials:**

Microorganisms in food: Dairy products like Milk, yogurts, cheese-Fermentation: ethanol, alcohol, SCP. Food spoilage and Beverages.

### **Unit 5: Microbes and their Application:**

Microbes in Pharmaceutical industries-Antibiotics& vaccines: penicillin etc...

Microbes as Bio fertilizers, Bio pesticides, Bio conversion, Spirulina, Bio polymers: petroleum leeching, bioinfectant and Microbes mining.

### **Prescribed books:**

- 1.) Microbiology :Concepts and Applications by Michael J. Pelczar - [Science](#) - 1993 - 800 pages
- 2.) P.K.Gupta Rastogi Co. Industrial Microbiology - Casida, Wiley Eastern publishers, 1994

### **Reference books:**

- 1.) Industrial Microbiology-Prescott and Dunn
- 2.) Microbiology by Lansing M.Prescott, Donald A.Klein, John P. Harley(1996)

## APPLIED BIOTECHNIQUES

### **Unit 1: Histological and Microscopic technique and their uses: 9 hours**

Fixation; dehydration; clearing; embedding; microtomy; staining; Interpreting section; helpful hints; Artifacts.

Microscopy: principles of microscopic technique; Light microscopy, Phase contrast and their uses; Interference confocal and electron microscopy – SEM and TEM and their uses; Fluorescence microscopy and their uses; cryoelectron microscopy; image analysis.

### **Unit 2: Centrifugation Techniques: 9 hours**

Principles of centrifugation, types and applications - Tabletop/clinical/desktop centrifuge or micro centrifuge, High-speed centrifuge, Cooling centrifuge, Ultra-centrifuge and their uses. Analytical centrifugation.

**Unit 3: Chromatography:** **9 hours**

Chromatography - basic principles of partition and adsorption; types - Paper, TLC, Column, Gel permeation, ion exchange, affinity, HPLC, GLC and their uses.

**Unit 4: Spectroscopic Analysis:** **9 hours**

Spectrophotometry - principle of spectrophotometer, Raman, IR, MS, GC-MS, IFTR, AAS and their uses.

**Unit 5: Techniques applied for Nucleic acid and Proteins and their uses:9 hrs**

Methods of extraction of nuclei acids and proteins from cell, DNA fingerprinting: RAPD, AFLP, and sequencing, Electrophoresis of DNA and Proteins: SDS-PAGE: 1D and 2D gels - isotacophoresis, capillary electrophoresis: Agarose gel; PFGF; Southern blotting and Ribotyping; Northern blot analysis and Western blotting.

**Prescribed Books:**

- 1) **Principles and Techniques of Biochemistry and Molecular Biology** by Keith Wilson and John Walker.
- 2) **Bioinstrumentation** by L.Veerakumari: MJP publishers.
- 3) **Biophysical Chemistry (Principles & Techniques)** by Upadhyay: Himalaya Publishing House

**Reference Books:**

- 1) **Methods in Nucleic Acids Research** By Jim D. Karam, Lee Chao, Gregory W. Warr,
- 2) **Molecular Diagnostics** by George P. Patrinos, Wilhelm Ansorge
- 3) **Chromatography: Concepts and Contrasts** by James M. Miller; Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

**Web site:**

[http://www.biotechniques.com/default.asp?page=article\\_archive&subsection=listing&year=1998&issue=10/1/1998](http://www.biotechniques.com/default.asp?page=article_archive&subsection=listing&year=1998&issue=10/1/1998)

<http://learn.genetics.utah.edu/units/biotech/index.cfm>

<http://www.biotechniques.org/>

<http://www.nsti.org/Nanotech2007/mediasponsor.html?id=41>

**MOLECULAR INTERACTIONS OF BIOMOLECULES****Unit I: Introduction to Chemical Bonding: 9 hours**

Principles - Chirality, Symmetry in organic compounds, Molecular isomerism: Time scales and energy criteria, conformational principles, conformational space Types of movements - vibrational, rotational, torsion angles, Conformational analysis, calculation of surface areas, volumes and radius of biomolecules.

**Unit II : Conformational Analysis: 9 hours**

Fundamentals of atomic and molecular orbital's: Theory of atomic and molecular orbital's; Linear combination of atomic orbital's; Quantitative treatment of valence bond theory and molecular orbital theory; Resonance structures; Phi-bonds and Chi bonds.

**Unit III: Stereochemistry and Molecular Interactions: 9 hours**

Fundamentals of chemical bonding and non-bonding interactions: Electrovalent bond, stability of electrovalent bond, stability of electrovalent compounds; co-valent bond - shape of orbital and hybridization. Molecular geometry, partial ionic character of co-valent bonds. Co-ordination bond, Vander Walls forces; Metallic bond, Dipole-Dipole interactions.

**Unit IV: Structural Analysis: 9 hours**

Pi ... Pi interactions, C - H ... Pi interactions -Molecular interactions: Protein - Protein, Protein - DNA, DNA - Drug, Protein - Lipid, Protein -Ligand, Protein - Carbohydrate, Metalloproteins, Glucosidic bond, rotational isomers & ribose puckering, back bone rotational angles & forces stabilising ordered forms, base pairing, base stacking.

**Unit V : Folding pathways: 9 hours**

Principles of protein folding, hydrophobic interactions, electrostatic interactions, non-bonded interactions, dispersive interactions, beta turns, gamma turns, types of helices, Disulphide Bridge, Role of unusual amino acids dictating protein folding.

**Prescribed Books:**

1. A.M.Lesk, "Protein Architecture - A Practical approach", Oirl Press Oxford.
2. Arthur.M.Lesk, "Introduction to Protein Architecture", Oxford press.
3. David Freifelder, "Physical chemistry - Application to Biochemistry & Molecular Biology", 2<sup>nd</sup> Edition, W.H.Freeman & Company.
4. David Whitford, "Proteins - Structure & Function", Wiley Publication.

**Reference Books:**

1. Bengt Nolting, "Protein folding kinetics - Biophysical methods", Springer Publication.
2. Ruth Hogue Angeletti, "Proteins - Analysis & Design", Academic Press.
3. S.R.Gadre, R.N.Shirsat, "Electrostatics of Atoms & Molecules", University press.
4. Sheehan, "Physical Biochemistry", Wiley Publication.

**Reference Websites:**

- 1 <http://www.whatislife.com/reader/interaction-reader.html>
- 2 <http://www2.hu-berlin.de/chemie/nmr/research-subjects/research-molecular-interaction-en.htm>
- 3 <http://www.everyscience.com/Chemistry/Organic/Stereochemistry/a.1091.php>

## OBJECT ORIENTED PROGRAMMING IN C++

**Aim:** The subject aims to introduce the salient features of Object Oriented Programming, evolution of c++ as a object oriented programming language with focus on generic programming with templates and Exception Handling.

**Objectives:** Students will be able to know the fundamentals of object oriented programming and incorporate OOPs' features such as inheritance, polymorphism, templates using c++ as language.

### UNIT - I

**Introduction to Fundamentals concepts:** Object oriented fundamentals- Structured versus object-oriented development, elements of object oriented programming, fundamentals of OO-class, object, and abstraction and its importance, encapsulation, polymorphism, benefits of OOP, structure of C++ program.

### UNIT - II

**Classes and Objects:** Working with classes- Classes and Objects- Class specification, class objects, accessing class members, defining member functions, inline functions, accessing member functions within class, data hiding, class member accessibility, empty classes, constructors, parameterized constructors, constructor overloading, copy constructor, new, delete operators, "this" pointer, friend classes and friend functions.

### UNIT - III

**Overloading:** Overloading-Function overloading, operator overloading-overloadable operators, unary operator overloading, operator keyword, limitations of increment/decrement operators, binary operator overloading, arithmetic operators, concatenation of strings, comparison operators, Generic programming with templates-Function templates, class templates.

### UNIT - IV

**Inheritance:** Inheritance- Base class and derived class relationship, derived class declaration, Forms of inheritance, inheritance and member accessibility, constructors in derived class, destructors in derived class, constructor invocation and data member initialization, data conversion, abstract classes, virtual base classes, virtual functions.

### UNIT - V

**Exception handling and Files:** Files and Streams-Opening and Closing a file, file modes, file pointers and their manipulation, sequential access to a file, ASCII and binary files, random access to a file, error handling during file manipulations, Exception handling-exception handling model, exception handling constructs, lists of exceptions, catching exceptions, handling exceptions.

### TEXT BOOK:

1. K.R.Venugopal, T.Ravishankar, and Rajkumar, "Mastering C++", Tata McGraw Hill, 1997

**REFERENCE BOOKS:**

1. E.Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill, 2<sup>nd</sup> Edition, 2004,
2. Bjarne stroustrup, "The C++ programming Language", Addison Wesley, 3<sup>rd</sup> edition, 1988.

## OBJECT ORIENTED PROGRAMMING LAB

### C++

1. Programs Using Functions
  - Functions with default arguments
  - Implementation of Call by Value, Call by Address and Call by Reference
2. Simple Classes for understanding objects, member functions and Constructors
  - Classes with primitive data members
  - Classes with arrays as data members
  - Classes with pointers as data members - String Class
  - Classes with constant data members
  - Classes with static member functions
3. Compile time Polymorphism
  - Operator Overloading including Unary and Binary Operators.
  - Function Overloading
4. Runtime Polymorphism
  - Inheritance
  - Virtual functions
  - Virtual Base Classes
  - Templates
5. File Handling
  - Sequential access
  - Random access
6. Sequencing and construction Methods
  - NCBI - Protein and Nucleic acids
  - EMBL - Protein and Nucleic acids
7. Transcription of DNA Program
8. Translation process program
9. Reverse Transcription Program
10. Replication process Program

## **MICROBIOLOGY LAB**

### **1. Fundamental Skills of the Microbiology Laboratory**

- General Guidelines in Microbiology Laboratory
- Nutrient Agar and Nutrient Broth Preparation
- Sterilization Methods
- Aseptic Transfers

### **2. Cultivation, Enumeration and Growth of Bacterial Cultures**

- Growth Curve of Bacteria
- Enumeration of Bacteria from Soil & Water Samples
- Bacterial Colony Morphology

### **3. Isolation & Pure Culture Techniques**

- Streak Plate Method of Isolation
- Spread Plate Method of Isolation
- Pour Plate Method of Isolation
- Mannitol Salt Agar (MSA)
- Agar Slant Preparation

### **4. Biochemical Tests**

- Fermentation Tests
- Methyl Red and Voges-Proskauer (MR/VP) Tests
- Catalase Test
- Oxidase Test

### **5. Observation of Microbial Motility**

- Hanging Drop Method.

### **6. Drug Sensitivity Test**

- Antibiotic Disc Assay