PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011

DEGREE OF BACHELOR OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR B.Sc. BIOINFORMATICS

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2012 – 2013 ONWARDS
REGULATIONS

1. ELIGIBILITY FOR ADMISSION

A candidate who has passed in Higher Secondary Examination with Biology or Pure Science (Academic stream or Vocational stream) as one of the subject under Higher Secondary Board of Examination, Tamilnadu as per norms set by the Government of Tamilnadu or an Examination accepted as equivalent thereto by the syndicate, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the Bachelor of Bioinformatics degree examination of this university after a course of study of three academic years.

2. DURATION OF THE COURSE

The course shall extend over a period of three years comprising of six semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

3. COURSE OF STUDY

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time. The syllabus for various subjects shall be clearly demarcated into five viable units in each paper/subject. Part -I, Part-II, Part – III and Part – IV subjects are as prescribed in the scheme of examination.

4. EXAMINATIONS

The theory examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination. The practical examinations for UG course should be conducted at the end of the even semester.
4.(a) Submission of record note books for practical examinations

Candidates appearing for practical examinations should submit bonafide
Record Note Books prescribed for practical examinations, otherwise the
candidates will not be permitted to appear for the practical examinations.
However, in genuine cases where the students, who could not submit the
record note books, they may be permitted to appear for the practical
examinations, provided the concerned Head of the department from the
institution of the candidate certified that the candidate has performed
the experiments prescribed for the course. For such candidates who do
not submit Record Books, zero (0) marks will be awarded for record note
books.

5. Revision of Regulations and Curriculum

The University may revise /amend/ change the Regulations and Scheme
of Examinations, if found necessary.

6(a). Passing Minimum – Theory

The candidate shall be declared to have passed the examination if the
candidate secure not less than 40 marks out of 100 (CIA – 10 marks out
of 25 and EA – 30 marks out of 75) in the University examination in
each theory paper.

6(b). Passing Minimum – Practical

The candidate shall be declared to have passed the examination if the
candidate secure not less than 40 marks put together out of 100 (CIA –
16 marks out of 40 and EA – 24 marks out of 60) in the University
examination in each practical paper.

7. Question Paper Pattern


PART – A (10 x 2 = 20 Marks)

(Answer ALL questions), (Two questions from each unit)

PART – B (5 x 5 = 25 Marks)

(Answer ALL questions) & (One question from each unit with
Internal Choice)

PART – C (3 x 10 = 30 Marks)
(Answer ANY THREE questions) & (Open Choice – 3 out of 5 questions)

7.1(b). THEORY - Internal Marks Distribution[CIA] (Total Marks: 25)

- Attendance : 5 Marks
- Assignment : 5 Marks
- Internal Examinations : 15 Marks

7.2(a). PRACTICAL – Marks Distribution & Question paper Pattern

(Max. Marks: 100)

[External [EA]: 60 Marks & Internal [CIA]: 40 Marks]

8. Commencement of this Regulation

These regulations shall take effect from the academic year 2012-2013, i.e, for students who are to be admitted to the first year of the course during the academic year 2012-2013 and thereafter.
<table>
<thead>
<tr>
<th>Sem Part</th>
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<th>Subject</th>
<th>Credit</th>
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<td>Practical - I (Cell Biology &amp; Biophysics)</td>
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<td>Allied I : Basic Mathematics</td>
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| SEMESTER – II |         |                                  | CIA    | EA    | Total |
| I            |          | Tamil - II                       | 3      | 25    | 75    | 100   |
| II           |          | English – II                     | 3      | 25    | 75    | 100   |
| II           |          | Biophysics                       | 4      | 25    | 75    | 100   |
| III          |          | Major Practical - I (Cell Biology & Biophysics) | 6    | 40    | 60    | 100   |
| III          |          | Allied II: Fundamentals of computer and office automation | 4    | 25    | 75    | 100   |
| III          |          | Allied Practical - I (Computer lab) | 6    | 25    | 75    | 100   |
| IV           |          | Env. Studies                     | 2      | 25    | 75    | 100   |
|              |          | **Total**                        | **28** | **190** | **510** | **700** |
### SEMESTER – III

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<td>Microbiology</td>
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<td>NME-1 Fundamentals of Bioinformatics</td>
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<td>Biological Data bank and their analysis</td>
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**SEMESTER – VI**

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<td>Object oriented programming and C++</td>
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<td>Major Practical III: Lab in Molecular Biology and Plant Biotechnology</td>
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**Total Credits: 140**

**Total Marks: 3600**
SEMESTER – I

UBI 111- MAJOR PAPER- I

CELL BIOLOGY

UNIT I

Cell as a basic unit, classification of cell types, cell theory, organization of plant and animal cells, comparison of microbial, plant and animal cell.

UNIT II

Ultrastructure of cells, Biochemical composition of cells (nucleic acid, carbohydrate, protein and lipids).

UNIT III

Subcellular organization, cytosol, endoplasmic reticulum, nucleus, cytoskeleton, ribosomes, mitochondria, chloroplast, vacuoles, peroxisomes, lysosomes and cell wall.

UNIT IV

Structure and function of cell membranes, Cell division (eukaryotic and prokaryotic), mitosis, meiosis and cell cycle.

UNIT V

Specialized cell, motile cells, nerve cells, muscle cells, cell death and apoptosis.

Recommended Books:

- De Robertis and De Robertis. 2005. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins


UNIT I
Energetics of a living body, sources of heat limits to temperature (qualitative treatment), heat dissipation to conservation, laws of thermodynamics. Nature of chemical bonds, intra and intermolecular interaction in biological systems.

UNIT II
Absorption spectroscopy- Beer-Lambert’s law, Colorimetry to Spectrophotometry( single and double beam spectrophotometer), primary biophysical events in photosynthesis.

UNIT III
Spectroscopic techniques to find out molecular structure (quantitative techniques), general spectroscopy (UV, Visible, Fluorescence, Atomic absorption, IR to Raman spectra).

UNIT IV
Physical methods of imaging, intact biological structures (X-ray, CAT-Scan, ECG, EEG, NMR) and radioactive pollution- GM counter.

UNIT V
Structure of proteins – primary, secondary, tertiary and quaternary. X-ray crystallography
Physical methods for determining size and shape of macromolecules – diffusion to sedimentation, reverse osmosis, ultracentrifugation

Recommended Books:
Volkones, HV, General biophysics Vol I&II.
Pullman, B and M.Voino. Molecular biophysics.
SEMESTER –II

UBIP121- MAJOR PRACTICAL-1

CELL BIOLOGY & BIOPHYSICS

1. Cell types – Microbial, animal and plant morphometric measurements.
2. Fractionation of cellular components.
5. Enzymes: Assay of urease, demonstration catalytic activity.
6. Titration curve of amino acids.
7. Selection of complementary filters.
Allied paper - II (Semster – II)

FUNDAMENTALS OF COMPUTER AND OFFICE AUTOMATION

(This paper is introduced instead of Allied paper - II: Computer Fundamentals and Basic programming)

UNIT I


UNIT – II


UNIT – III


UNIT – IV

MS-EXCEL: Creating a Simple Spreadsheet – Editing a Spreadsheet – Working with Functions and Formula – Formatting Worksheets – Completing Your Spreadsheet – Creating Charts

UNIT – V

MS-POWERPOINT: Creating and Viewing Presentations – Editing a Presentation – Working with Presentation Special Effects

TEXT BOOKS

Allied Practical –I: Computer lab

(This practical lab is introduced instead of Allied Practical –I: Computer fundamentals and Basic programming)

Semester II: Lab exercise

MS Office

1. Create a document with tables, and do the following
   Formatting, tab setting, page setting for printing, and Header & Footer setting

2. Drawing flow chart using drawing toolbar, inserting picture and setting frames

3. Mail Merge in word (Creating main document, data source, inserting merge fields and
   viewing merge data, viewing and printing merged letter, using main merge to print envelope creating mailing labels)

4. Create a document, Format the document and edit the document as follows:
   (i). Find and Replace options
   (iii). Cut, Copy and Paste options
   (vii). Chance Character size using the font dialog box.
   (viii). Formatting paragraph: Center, Left aligns & Right aligns
   (viii). Changing paragraph and line spacing Using Bullets and Numbering in paragraphs
   (viii). Creating Hanging paragraphs

MS – EXCEL

1. Create a work sheet, moving / copying / inserting / deleting rows and Columns. (Usage of cut, paste commands, copying a single cell, copying a range of data, filling up a cell. Undo command, Inserting a row, column Deleting rows and columns.)

2. Create a worksheet and perform to date, time ,Math functions, and Logical and financial functions

3.a. Data base concept: Data base, Record field and field name – creating and sorting a data base and maintaining a data base (date form)
   b. Using auto filter, advanced filter
   c. Creating subtotals and grand totals – Using database functions
4. Creating charts (pie, Bar, Line)
   a. Using chart wizard (five steps)
   b. Changing the chart type (pie, Bar, Line)
   c. Inserting titles for the Axes x, y
   d. Changing colors
   e. Printing charts

MS – POWER POINT
1. Creating a presentation using auto content wizard
2. Different views in power point presentation
3. Setting animation effects / grouping / ungrouping / cropping power/point objects
4. Design to presentation to market the product using animation effects/ buttons/links
SEMESTER – II
Non Major Elective Courses
NME –I
Fundamentals of Bioinformatics

Unit –I
Bioinformatics-Definition, History, Scope and Applications. Opportunities in Bioinformatics. Emerging areas of Bioinformatics

Unit II
Computers and Programming Languages. Internet, World Wide Web, Browsers, Search Engines – Google, Yahoo

Unit III
Cell Structures and Cell Organelles. Introduction to Macromolecules like DNA, RNA and Proteins

Unit IV
Introduction to Molecular Biology and genetics. Central dogma of life: DNA – RNA - Protein. Role of Bioinformatics in Human Genome Project

Unit –V
Biological databases, Importance of databases, Nucleic acid sequence databases, Protein databases and Structure databases

References

UNIT 1
Microbial study: Types of Microscopes (Light, Phase-contrast and Electron microscopy) – classification of microorganisms - viruses, bacteria, fungi, algae and protozoans.

UNIT II

UNIT III
Viruses (Lytic and Lysogenic), Bacterial genetics: Plasmids and conjugation, transduction and transformation. Mutations, mutagenesis and recombination.

UNIT IV

UNIT V

Recommended Books

SEMESTER – III
UBIP221 MAJOR PRACTICAL - II
MICROBIOLOGY

1. Staining techniques - gram staining, negative staining, flagellar staining and spore staining.
3. Various sterilization techniques – surface, glassware, media, dry heat, wet heat, radiation, chemicals and filtration.
4. Preparation of solid and liquid media.
5. Isolation of micro organisms from soil, air, plants and water by streak plate, pour plate and spread plate methods
6. Maintenance of cultures – soil stock, glycerol stock and lyophilisation
7. Biochemical test- starch hydrolysis, catalase production, milk curdling, fluorescence, acid and gas production by Durham tube, IMVIC.
Applications of Bioinformatics

Unit –I
Protein Structure prediction, Gene and Protein expression data. Protein interaction data, Similarity and database searching tools – FASTA, BLAST

Unit II
Protein sequence data banks, NBRF, PIR, SWISSPROT, Nucleic Acid Sequence Data Bank, EMBL & NCBI

Unit III
Sequence analysis and Phylogeny – sequence search alignment- spair wise and multible sequence. Scoring matrices. Introduction to Phylogenetic Trees.

Unit IV

Unit V
Structure of commonly used drugs in medical field. New drug design for cancer. Identification of novel drug design with least side effect.

References
1. Introduction to Bioinformatics - S.Sundararajan and Balaji
3. Bioinformatics basic skills and applications - Rastogi
UNIT 1


UNIT II

Data - primary, secondary. Methods of data collection. Merits and limitations. Classification, tabulation and presentation of data.

UNIT III


UNIT IV

Correlation and regression, similarities and dissimilarities of correlation and regression.

UNIT V

Statistical interference – hypothesis: simple hypothesis, Hypothesis testing. Student’s t test, Chi-Square test, ANOVA.

Recommended Books


Freedman, P, 1950. The principles of scientific research, Pergamon press, NY.
SEMESTER V
UBI311 MAJOR PAPER - V
MOLECULAR BIOLOGY

Unit I
Cell structure and function: Membrane architecture, membrane associated process, ATP synthesis and photosynthesis, subcellular organelles- mitochondria, chloroplast.

Unit II

Unit III

Unit IV
Mutations and mutant, Biochemical basis of mutation, types of mutation – spontaneous and conditional. Chemical and physical mutagens- point mutation.

Unit V
Transposons and insertion sequences: Types of transposons – prokaryotes and eukaryotes. DNA rearrangement mediated by transposons.

Recommended Books

SEMESTER V
UBI312 MAJOR PAPER - VI
BIOLOGICAL DATABANKS AND THEIR ANALYSIS

Unit I
DNA and protein sequence data banks, NCBI, EMBL, DDBJ, NBRF-PIR, SWISSPROT, signal peptide databank.

Unit II
Analytical tools for sequences databanks: BLAST, FASTA, Pairwise alignment- Multiple alignment- ClustalW, PRAS.

Unit III
Structural databanks: Protein databank (PDB), the Cambridge structural database, Genome databank, metabolic pathway databanks- KEGG and Meta Cyc.

Unit IV
Introduction to microbial strain data network, numerical coding system of microbes, hybridoma data bank structure, virus and cell line information system.

Unit V
Protein structure classification databases: SCOP and CATH, Human genome and diseases database – OMIM.

Recommended Books

SEMESTER V

UBI313 MAJOR PAPER- VII

IMMUNOLOGY

UNIT I

UNIT II

UNIT III
Organization and expression of immunoglobulin genes. Major Histocompatibility Complex (MHC) and antigen.

UNIT IV

UNIT V
Immune regulation, Vaccines, autoimmunity, immune response to infectious and immuno-deficiency diseases.

Recommended Books

SEMESTER V

UBI314- MAJOR-PAPER-VIII

PLANT AND ANIMAL BIOTECHNOLOGY

UNIT I

Application of plant tissue culture, organogenesis and somatic embryogenesis. Protoplast culture and fusion. *Agrobacterium* mediated transformation in plants, production of secondary metabolites by cell culture.

UNIT II


UNIT III

Animal cell culture: historical perspectives and applications, manipulation of animal cells (microinjection, electroporation, liposome mediated transformation). Production of native and recombinant proteins - animal viral vectors.

UNIT IV


UNIT V

Transgenic animals: gene targeting , types of vaccines recombinant and DNA vaccines, production and its applications.

Recommended Books

SEMESTER V
UBI315 MAJOR PAPER – IX
RELATIONAL DATABASES MANAGEMENT SYSTEMS

Unit I
Purpose of database systems-Entity relationship model: mapping constraints-primary keys-ER diagram.

Unit II
Relational model: Structure-formal query languages-relational Algebra-relational calculus-commercial query language.

Unit III

Unit IV
Hierarchial data model: Tree structure diagram-data retrieval, Networks data model: Data structure diagram-DBTG CODASYL model, updating and set processing.

Unit V
Interpretation-equivalence of expressions-Query processing cost- query optimizer. Basic concepts of data base recovery-currency control, database security and integrity-distributed database.

Recommended Books
SEMESTER VI

UBI321- MAJOR PAPER – X

SYSTEMIC EVOLUTION AND ENVIRONMENTAL BIOLOGY

UNIT-I
Morphological classification of plants: Various systems, Binomial nomenclature; Cyto and chemotaxonomy.

UNIT-II
Morphology and Whittaker’s five kingdom classification of animals, animal diversity, classification of chordates and non-chordates up to classes.

UNIT-III

UNIT-IV
Environmental biology: Autoecology, synecology, ecosystem and its components, energy flow, primary productivity, food chain. Wild life preservation and management, water, air and noise pollution. Global warming and Marine pollution (Oil spills).

UNIT-V
Function of ecosystems. Vegetation pattern in South India. Pollution and soil conservation. Afforestation and social forestry. A general account of renewable and non renewable resources.

Recommended Books

SEMESTER VI

UBI322-MAJOR PAPER – XI

DRUG AND MOLECULAR MODELLING

UNIT I

Classification of drugs, routes of drug administration. Absorption & Distribution of drugs. Role of kidney in drug interaction with biomolecules. Binding of drugs to plasma proteins.

UNIT II

Drug receptors: Drug-receptor interaction, Drug action not mediated by receptors. Structural based drug design, mechanism of their action. Lipinski’s rule of 5, Clinical trials 1-4 phases.

UNIT III

Effect of drug doses on the rate of metabolism- mechanisms and importance of Phase I and Phase II biotransformation. Role of cytochrome p450. Enzyme inhibition strategies, enzyme induction and pharmacological activity, LD$_{50}$ and IC$_{50}$.

UNIT IV


UNIT V

Quantitative Structure Activity Relationship (QSAR). Types of descriptors-constitutional, topological, charge, quantum chemical, walk and path counts, geometric descriptors. Types of QSAR methods-In static contour plot, in electro static contour plots, 3D-QSAR.
Recommended Books


SEMESTER VI

UBI323-MAJOR PAPER-XII

PROTEOMICS AND GENOMICS

UNIT I

Algorithms and applications of proteomics: proteome mining, protein expression profiling, protein-protein interaction, protein modification and automation.

UNIT II

Protein digestion techniques, 2D Electrophoresis, Isoelectric focusing (IEF), High Performance Liquid Chromatography- Mass Spectroscopy (HPLC-MS).

UNIT III

Overview of genome, genome sequence acquisition and analysis, comparative homologies, evolutionary changes, Single Nucleotide Polymorphism (SNPs). Genetic analysis: linkage mapping and analysis; physical mapping, Microarrays; sequence specific tags, sequence tagged sites, ISH, FISH.

UNIT IV


UNIT V

Construction of cDNA and genomic DNA libraries; Polymerase Chain Reaction (PCR), Yeast two-hybrid system, SAGE Adaptation for Downsized Extract (SADE), ESTs,
Recommended Books


SEMESTER VI

UBI324 MAJOR PAPER – XIII

DATA MINING AND WAREHOUSING

(This paper is introduced instead of Major Paper-XIII: Parallel Computing and programming in PERL)

UNIT – I

Introduction: Data mining application – data mining techniques – data mining case studies- the future of data mining – data mining software -
Association rules mining: Introduction- basics- task and a naïve algorithm- apriori algorithm – improve the efficient of the apriori algorithm – mining frequent pattern without candidate generation

UNIT – II


UNIT – III


UNIT – IV

UNIT – V

**Data warehousing:** Introduction – Operational data sources- data warehousing - Data warehousing design – Guidelines for data warehousing implementation - Data warehousing metadata - **Online analytical processing (OLAP):** Introduction – OLAP characteristics of OLAP system – Multidimensional view and data cube - Data cube implementation - Data cube operations OLAP implementation guidelines

**TEXT BOOK:**


**BI324 MAJOR PAPER – XIV**

**OBJECT ORIENTED PROGRAMMING AND C++**

**Unit I**

Principles of object oriented programming (OOP): Software evolution-OOP paradigm-basic concepts of OOP-object oriented languages-applications of OOP.

**Unit II**


**Unit III**

Classes and objects: constructors and destructors and operating overloading and type conversions.

**Unit IV**

Unit V

Working with files: Classes for file stream operations-opening and closing a file-end of file (EOF), file detection-file pointers-updating a file-error handling during file operations-command line arguments.

Recommended Books

- Balagurusamy, E. 1995. Object oriented programming with C++, TMH.

SEMESTER-VI

UBIP321 – PRACTICAL III

LAB IN MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY

1. Isolation of plasmid and analysis by Agarose gel electrophoresis
2. SDS-PAGE
3. Mutagenesis
4. Determination of molecular size of DNA
5. Restriction analysis of DNA
6. Ligation of DNA into vectors
7. Transformation
8. Preparation of culture medium and basic sterilization techniques
9. Organ culture
10. Callus induction
11. Shoot tip culture
12. Isolation of Plant DNA and analysis by Agarose gel electrophoresis
1. PDB analysis of protein structure by RASMOL
2. NCBI, EMBL and DDBJ (accession of informations)
3. BLAST and FASTA search
4. Alignments – pair wise and multiple sequence alignment – Clustal W and X
5. Program for function, operation overloading
6. program for multiple constructors in a class
7. program for multiple handling
8. program for error handling
9. program for friend and virtual functions
10. Molecular mechanics and dynamics of nucleotides and proteins.
11. Molecular modelling using HEX.
SKILL BASED ELECTIVE COURSES

1. Microbial diversity
2. Medical Laboratory techniques
3. Recombinant DNA technology I
4. Recombinant DNA technology II
5. Microbial Biotechnology I
6. Microbial Biotechnology II

NON MAJOR ELECTIVE COURSES

1. Bioinstrumentation I
2. Bioinstrumentation II

PART IV

1. Environmental Studies
2. Value Education - Yoga

PART V

1. Extension Activities