FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc.(HONOURS) BIOINFORMATICS

1ST, 2ND & 3RD YEAR

EXAMINATIONS 2013

--:O:--
B.Sc. (Hons.) Bioinformatics
Session 2012-2013

- Syllabi, courses of study and credits in basic papers will be same for both Biotechnology (Hons.) & Bioinformatics (Hons.). These papers will include English, Chemistry, Physics and Statistics & Computer Fundamentals. In addition, there will be:

  - Mathematics (for +2 medical)
    AND
    Life Sciences (for +2 non-medical)

- Year-wise marks distribution for both the (Hons.) Course will be:
  
<table>
<thead>
<tr>
<th>Year</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I yr</td>
<td>1000</td>
</tr>
<tr>
<td>II yr</td>
<td>1000</td>
</tr>
<tr>
<td>III yr</td>
<td>1000</td>
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Grand Total = 3000

- For all the papers BIN 1002-1008
  - Set nine questions in all. Question No.1 (Objective type) is compulsory
  - Divide the questions 2 to 8 into 2/3 parts
  - Set 2 questions from each unit and one is to be attempted from each unit
### Outlines of Courses for B.Sc. (Hons.) Bioinformatics 1st Year

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Subject</th>
<th>Lectures / week</th>
<th>Max Marks</th>
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<tr>
<td></td>
<td>Environment &amp; Road Safety Education</td>
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<td></td>
<td>English</td>
<td>3</td>
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<td></td>
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<td>2</td>
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<td>BIN-1001</td>
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<td>6</td>
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<td>6</td>
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<td>Life Sciences (Practical) OR,</td>
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<td>Mathematics (Practical)</td>
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<td>Chemistry (Practical)</td>
<td>3</td>
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<tr>
<td>BIN-1054</td>
<td>Statistics &amp; Computer Fundamentals (Practical)</td>
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<td>Introduction to Biochemistry &amp; Bioinformatics (Practical)</td>
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**Total** = (Theory + Practical) = 700 + 300 = 1000
Outlines of Courses for B.Sc. (Hons.) Bioinformatics II\textsuperscript{nd} Year

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<tr>
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<td>BIN-2002</td>
<td>Computational Methods in Bio-molecular Sequence &amp; Structure Analysis</td>
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<td>BIN-2003</td>
<td>Object Oriented Programming in C++</td>
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<td>BIN-2004</td>
<td>Computer Operational System and Organization</td>
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<td>BIN-2005</td>
<td>Statistical Methods</td>
<td>6</td>
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</tr>
<tr>
<td>BIN-2006</td>
<td>Physical Chemistry</td>
<td>6</td>
<td>90+10=100</td>
</tr>
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<td>Fundamentals of Molecular Biology and Genetic Engineering (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<tr>
<td>BIN-2052</td>
<td>Computational Methods in Bio-molecular Sequence Analysis (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<td>BIN-2053</td>
<td>Object Oriented Programming in C++ (Practical)</td>
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<tr>
<td>BIN-2055</td>
<td>Statistical Methods (Practical)</td>
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<td>45+5=50</td>
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<tr>
<td>BIN-2056</td>
<td>Physical Chemistry (Practical)</td>
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<tr>
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Total = (Theory + Practical) = 600 + 300 + 100 = 1000

Outlines of Courses for B.Sc. (Hons.) Bioinformatics III\textsuperscript{rd} Year

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<thead>
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</tr>
<tr>
<td>BIN-3002</td>
<td>Fundamentals of Genomics</td>
<td>6</td>
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<td>Introduction to Proteins and Proteomics</td>
<td>6</td>
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</tr>
<tr>
<td>BIN-3004</td>
<td>Principles of Genetics</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3005</td>
<td>Biochemical and Molecular Biology techniques</td>
<td>6</td>
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<tr>
<td>BIN-3006</td>
<td>Cell Biology &amp; Immunology</td>
<td>6</td>
<td>90+10=100</td>
</tr>
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<td>BIN-3051</td>
<td>Introduction to PERL Programming (Practical)</td>
<td>3</td>
<td>45+5=50</td>
</tr>
<tr>
<td>BIN-3052</td>
<td>Fundamental of Genomics (Practical)</td>
<td>3</td>
<td>45+5=50</td>
</tr>
<tr>
<td>BIN-3053</td>
<td>Introduction to Proteins and Proteomics (Practical)</td>
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<td>BIN-3054</td>
<td>Principles of Genetics (Practical)</td>
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<td>BIN-3055</td>
<td>Biochemical and Molecular Biology techniques (Practical)</td>
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<tr>
<td>BIN-3056</td>
<td>Cell Biology &amp; Immunology (Practical)</td>
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<td>45+5=50</td>
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<tr>
<td>BIN-3057</td>
<td>Project Work</td>
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<td>100</td>
</tr>
</tbody>
</table>

Total = (Theory + Practical) = 600 + 300 + 100 = 1000
UNIT I (ENVIRONMENT)

1. **Environment Concept**: 
   Introduction, concept of biosphere—lithosphere, hydrosphere, atmosphere; Natural resources—their need and types; principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. **Atmosphere**: 
   Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. **Hydrosphere**: 
   Types of aquatic systems. Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. **Lithosphere**: 
   Earth crust, Soil—a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. **Forests**: 
   Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban forests, Chipko Andolan.

6. **Conservation of Environment**: 
   The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems—soil, water, air, wildlife, forests.

7. **Management of Solid Waste**: 
   Merits and demerits of different ways of solid waste management—open, dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. **Indoor Environment**: 
   Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. **Global Environmental Issues**: 
   Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

10. **Indian Laws on Environment**: 
    Indian laws pertaining to Environmental protection: Environment (Protection) Act, 1986; General information about Laws relating to control of air, water and noise pollution. What to do to seek redressal.
11. **Biodiversity** :
What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

12. **Noise and Microbial Pollution** :
Pollution due to noise and microbes and their effects.

13. **Human Population and Environment** :

14. **Social Issues** :
Environmental Ethics : Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

15. **Local Environmental Issues** :
Environmental problems in rural and urban areas, Problem of Congress grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

**Practicals** :
Depending on the available facility in the college, a visit to Vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

*Note : Above 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topics from 2 to 11 and one each for the topics 1 and 12 to 15.*

**UNIT II (ROAD SAFETY)**

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
4. Traffic Signs.
5. How to obtain Driving License.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.

**Examination Pattern** :
- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted question).
- The paper shall have two units: **Unit I (Environment) and Unit II (Road Safety).**
- Unit I shall comprise of 50 questions with minimum of 2 questions from each topics 1, and 12 to 15 and minimum of 4 questions from topics 2 to 11.
• Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.
• The entire syllabus of Unit I is to be covered in 25 hours and that of Unit II is to be covered in 10 hours.
• All questions are to be attempted.
• Qualifying Marks 33 per cent i.e. 23 marks out of 70.
• Duration of examination : 90 minutes.
• The paper setters are requested to set the questions strictly according to the syllabus.

**Suggested Readings**

2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

**Websites:**

(a) [www.chandigarhpolice.nic.in](http://www.chandigarhpolice.nic.in)
(b) [www.punjabpolice.gov.in](http://www.punjabpolice.gov.in)
(c) [www.haryanapolice.gov.in](http://www.haryanapolice.gov.in)
(d) [www.hppolice.nic.in](http://www.hppolice.nic.in)
Objectives
The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general.

Note:
(i) There will be one paper of 40 marks, 5 marks are reserved for the Internal Assessment and 5 for the Practical Work. Total is 50.

(ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.

(iii) For Unit I, the prescribed text is Varieties of Expression, Ed. A. H. Tak, Foundation Books, which shall replace the existing text Patterns in Prose by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e. prose and drama are prescribed. Poetry has been deleted completely. Only four prose and four plays have been recommended for the study. The relevant sections, however, are as follows:

UNIT-I
Prose:
I. The Judgement Seat of Vikramaditya, Sister Nivedita
II  Engine Trouble, R. K. Narayan
III The Conjurer’s Revenge, Stephen Leacock
IV  J. C. Bose, Aldous Huxley

Drama:
V  The Rising of the Moon, Lady Gregory
VI Waterloo, Arthur Conan Doyle
VII The Proposal, Anton Chekhov
VII Riders to the Sea, J. M. Synge

UNIT-II
(iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end Unit II shall consist of the following:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (no exceeding 200 words).

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, audio-visual aids and power-point presentations. Apart from
this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.

**Project work:-**
Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 10 pages) in consultation with teachers of science. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

(Note: In case of private candidates and students of School of Open Learning, the marks obtained by them out of 40 will be proportionately increased out of 50).

**Testing Scheme:**
The examination paper shall be divided into two units, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Unit I shall be as follows:

**Unit I** (It is text-based and corresponds to unit I in the syllabus)

Q1. It shall consist of *five* short questions (not exceeding 50-60 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text *Varieties of Expression* and cover a wide range of issues, topics and problems. It shall consist of 6 marks.

Q2. It shall consist of *two* long questions (not exceeding 100-150 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text *Varieties of Expression*. This shall carry 5 marks.

Note: The question 1 & 2 should be so designed as to cover all the chapters prescribed (Prose & Drama).

Q3. It shall consist of an *Unseen Passage for Comprehension* (not more than 400 words), with minimum three questions at the end. These questions should be designed in such a way that we are able to test a student’s comprehension ability, language/presentation skills and vocabulary etc. This question shall be of 6 marks.

Q.4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column. This shall carry 3 marks.

**Unit II** (Based upon Unit II)
Q.5 The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry 5 marks.
Q.6. This question shall test a student’s ability to write letters of various kinds (not more than 200 words). Again, there will be internal choice here and the question will be of **5 marks**.

Q.7. There will test a student’s ability to write a Précis. A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry **5 marks**.

Q.8. Two short questions out of four to be attempted form modern forms of communication **5 marks**.

**Suggested Reading:**

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<th>Description</th>
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### gnemeqv

- T) ftôokw fuzBQ
- n) tkeK B[z jo gzy'A; X e/ fbyDk
- J) w[ftomK dK tkeK ftu t'os'A
PAPER 2: HISTORY AND CULTURE OF PUNJAB

One Paper

General Instructions:
1. In all, nine questions will be set. Each question will carry 9 marks.
2. First question shall be Short Answer type containing 15 short questions spread over the whole syllabus. Candidates will attempt nine questions out of the fifteen questions in about 25 to 30 words each. Each short question will carry 1 mark, totalling 9×1=9 marks. The first question is compulsory.
3. Rest of the paper shall contain 4 units. Each unit shall have two essay type questions and the candidate shall attempt one question from each unit – 4 in all.
4. For private candidates, who have not been assessed earlier for internal assessment, the marks secured by them in theory paper will proportionately be increased to maximum marks of the paper in lieu of internal assessment. The paper setter must put note (4) in the question paper.

HISTORY AND CULTURE OF PUNJAB 1200-1849 A.D.

UNIT-I
1. Society in the Punjab during the Afghan rule.
2. The Punjab under the Great Mughals.

UNIT-II
4. Guru Nanak: His teachings; concept of Langar and Sangat.

UNIT-III
7. Martyrdom of Guru Tegh Bahadur; foundation of the Khalsa by Guru Gobind Singh.
8. Banda Bahadur and his achievements; Sikh Struggle for sovereignty from 1716 to 1765; role of Dal Khalsa, Rakhi, Gurmata and Misls.
9. Ranjit Singh’s rise to power; civil and military administrations; relations with the British.

UNIT-IV
10. Social change with special reference to the position of women.
11. New developments in language, literature, architecture in the Punjab during the Medieval Period.
12. Famous Folk tales of Medieval Punjab.

Suggested Readings:
1. Singh, Kirpal, History and Culture of the Punjab, Part-II (Medieval Period), Publication Bureau, Punjabi University, Patiala, 1990 (3rd edn.).

N.B. - The required detail and depth would conform to the treatment of the subject in the above survey. (This book will also form the basis of the short answer questions).


Note: - The following categories of the students shall be entitled to take the option of History & Culture of Punjab in lieu of Punjabi as compulsory subject:

(a) Students who are not domiciled in Punjab and have not studied Punjabi upto class 10th.
(b) Wards of/and Defence Personnel and Central Government employee/employees who are transferable on all India basis.

(c) Foreigners.
**Objective**

*It introduces the students of Non-medical background to the concepts of biological sciences which are integral understanding and application of Bioinformatics.*

**Instructions for the paper-setters and Candidates**

**Note:**

1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

**UNIT I**

**General Biology:** The nature of life, definition of life, Characteristics of life. Differences between animals and plants. Principal divisions in Biology, Importance of Biology

**Introduction to Various systems in human body:** Digestive system, Respiratory system, circulatory system, endocrine system, Reproductive system

**Introduction to various systems in Plants:** Basic anatomy of flowering plants: Nutrition, Transport, Reproduction

**UNIT II**

**Basics of Cell Biology:** Definition of cell, fundamental cell types, differences between prokaryotic and eukaryotic cell types, cell structure, cell wall, plasma membrane

Different organelles and their functions. Cell division, cell cycle and its regulation.

**Basics of Genetics and Evolution:** Mendel’s work and experiments, Gene bearer of heredity and character, chemical basis of heredity, Chromosome structure, Alternations in structure, Human karyotype.


**UNIT III**

**Basic Molecular Biology – I:** Nucleic acids (DNA and RNA)

Chemical structure, hybridization, double helical structures, replication, concepts of gene and genetic code, transcription and translation, mutations and their implications.

**Basic Molecular Biology – II:** Proteins
Amino acid structure, chemical nature of residues, levels of protein structure, polypeptide chain folding, concepts of pH, pK₁, buffer aqueous medium. Introduction to enzymes, their types and functions.

**Lipids:** fatty acids, acylglycerols, phospholipids, sphingolipids, cholesterol and membranes; Isoprenoids, eicosanoids, and their biological implications.

**Carbohydrates:** Monosaccharide, oligosaccharides, polysaccharides, proteoglycans and glycoproteins.

**UNIT IV**

**General microbiology:** A brief history of microbiology, Microbes in our lives, Definition of microorganisms, naming and classification of microorganisms. The diversity of microorganisms – Bacteria, Fungi, Protozoa, Algae, Viruses, Multicellular Animal Microorganisms living in humans and animals, their role, microorganisms used to produce food and chemicals, Disease causing microorganisms.

**Recommended books:**

**BIN 1051 LIFE SCIENCES (Practical Course)**

Max Marks 50 (45+5)

1. Preparation of Media, Cotton Plugging and Sterilization
3. Gram staining, other staining methods
4. Growth curve of bacteria
5. Testing of water quality
6. Antibiotic sensitivity of microbes
7. Isolation of mutants by UV and chemical mutagenesis
8. Killing curve
9. To study cell structure from onion leaf peels
10. Examination of various stages of mitosis and meiosis
11. Assay of enzyme activity (amylase)
12. Estimation of proteins by Lowry method, and estimation of sugars

OR
Objective
The objective is to introduce students about basic Mathematics including real members, functions, complex numbers, Trigonometric, Matrices and Determinates, Calculus, Differential Equations and Linear Programming. These techniques are useful in solving Bioinformatics Problems.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I
Real Numbers:
Different kinds of numbers, Integers, Rationals and Irrationals, Surds and their properties, Fractional Indices.
Set, relation and functions:
Set, Product of sets, relations, Functions (Polynomials, Trigonometric, Exponential), Graphical representation of functions.
Complex Numbers:
Extending the number system, Operations with complex numbers.

UNIT II
Elementary Mathematical logic and basic concepts of Boolean Algebra
Elementary Trigonometry:
Addition, Subtraction, A-B,C-D Formulas
Concept of A.P., G.P.
Elementary computing systems:
Binary, Octal and Hexadecimal system.
Binomial Theorem:
Expanding \((x+y)^n\) where \(n\) is a +ve integer and simple applications.

UNIT III
Matrices and Determinants
Matrix algebra and Determinants.
CALCULUS:
Differentiation : Limits of functions, Calculating gradients of chords first and second order derivatives.
Applications of derivatives: Increasing and decreasing functions, maximum and minimum points, Derivatives as rates of change
Integration: Finding a function from its derivative, Definite integral, Indefinite integral, Area under curves.
Differential Equations: Forming differential equations, Solutions of following types: Variable separable, Homogenous differential equation of the type \( \frac{dy}{dx} + Py = Q \) (\( P, Q \) are functions of \( x \) only).
Applications.

UNIT IV

Linear programming:
Formulating LPP and solution by graphical methods

Elementary statistics
Definition of Statistics, types of data, Primary and Secondary data, Discreet and continuous data, methods of data collection, diagrammatic representation of data (Bar, Pie, Line, Multiple bar diagrams).

Recommended books:
2. Textbook of NCERT (For class XI & XII), 2006.

BIN 1052 MATHEMATICS (PRACTICAL)

Max Marks 50 (45+5)

1. Sets (Venn-Diagram, Union, Intersection, Difference of sets, Symmetric Difference of sets, Complement of sets) (2 practicals).
2. Relations (graphical representation of relation from set A to set B or set A to set A) (1 practical).
3. Functions(Graph of standard functions, modulus, greatest, integer, exponential, \( \log x \), signum, sin, cos, tan, cot, sec, cosec,) (2 to 3 practicals).
4. Increasing and Decreasing (Polynomial functions)- wavy curve method (2 practicals).
5. Plotting of irrational numbers \( \sqrt{2}, \sqrt{3}, \sqrt{5} \) etc. on number line (1 practical)
6. Curve tracing (using Maxima and Minima, symmetry along X-axis, Y-axis, \( Y= X, Y = -X \), point of intersection with X-axis and Y-axis, \( f(|x|), | f(x) | \) (3 to 4 practical).
7. Histogram, pie chart, bar diagrams and Multiple bar diagram (2 to 3 practicals).
8. Argand plane (Plotting of complex numbers) (1 practical).
9. Binary to Decimal, Decimal to Binary, Binary addition, subtraction, multiplication (2 to 3 practicals).
10. Solving linear programming problem using graphical methods (2 practicals).
Objective
To introduce the basic concepts of Chemistry with application in biological Sciences.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I
Periodic properties
Position of elements in the periodic table, effective nuclear charge and its calculations, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination trends in periodic table and applications in predicting and explaining behaviour
Chemistry of Noble gases
Chemical properties of noble gases, chemistry of xenon, structure and bonding in xenon compounds. Clathrates, types and stability
Coordination compounds
Introduction, Wener’s coordination theory, naming of coordination compounds, Stereochemistry, Geometrical isomerism and optical isomerism in compounds having coordination number 4 and 6. Bonding in metal complexes

UNIT II
Chemical bonding
Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization, and shapes of inorganic molecules and ions – BeF₂, SnCl₂, XeF₄, BF₃, NH₃, H₂O, CIF₃, IC₁₂, PF₆, SF₆, and IF₇
Molecular Orbital Theory, Homonuclear (elements and ions of 1st and 2nd row) and heteronuclear (BO, CN, CO, NO, CN⁺), multicentric bonding in electron deficient molecules (BORANES)
Weak interactions; Hydrogen bonding and Van der Waals forces.
Some fundamental aspects of organic chemistry, inductive effect, electrometric effect, resonance, hyperconjugation, types of reagents, electrophiles and nucleophiles, types of organic reactions. Reaction intermediates – carbocations, carbanions, free radicals, carbenes (with examples)
Nomenclature and classification of Alkyl halides, Method of formation, Chemical Reactions, Mechanisms and stereochemistry of nucleophile substitution reactions of alkyl halides, SN2 and SN1 reactions with energy diagram. Methods of preparation of aryl halides. The elimination-
Addition mechanism (benzyne mechanism) and nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halide vs. allyl, vinyl, and aryl halides.

**Alcoholols and Phenols.**
Mechanism of dehydration, acidity, Fries rearrangement, Mechanism of Kolbe’s reaction. Reamer Tiemann reaction and mechanism, Electrophilic substitution reactions of Phenol.

**UNIT III**

**Aldehydes and Ketones**
Reactions with mechanism: Oxidation, reduction, amination, nucleophilic addition reaction, ketoenol tautomerism, aldol condensation, Cannizaro’s reaction, The Wittig’s reaction, Perkin’ reaction.

**Carboxylic acids and derivatives**

**Introduction to Quantum mechanics:**
Failure of classical mechanics, advent of quantum theory, Schrodinger wave equation (SWE), Physical interpretation of wave function, Quantization, solution of SWE for (i) particle in one dimensional box (ii) rigid bodies (iii) Harmonics oscillator (iv) Tunnelling and its applications in biological systems.

**Physical properties and molecular structure**
Optical activity, Polarization, orientation of dipoles in an electric field, dipole moment, magnetic properties.

**UNIT IV**

**Solutions**
Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient, Dilute solution, Osmotic pressure, its law and measurements. Elevation of boiling point and depression of freezing point.

**Chemical kinetics**
Scope, rate of reaction, influencing factors such as concentration, temperature, pressure, solvent etc. theories of chemical kinetics, Arrhenius Equation, Concept of Activation energy.

**Molecular Velocities**
Root mean, average and most probable velocities, qualitative discussion of Maxwells’s distribution of molecular velocities, collision number, mean free path.

**Recommended books:**
BIN 1053  CHEMISTRY (Practical Course)

Max Marks 50 (45+5)

Inorganic qualitative analysis
Four ions including interfering ions

Volumetric analysis
Iodimetry, iodometry, redox titrations using ceric sulphate, potassium dichromate and potassium permanganate
Complexometric titrations using EDTA of Ca$^{2+}$, Mg$^{2+}$ and Zn$^{2+}$.

BIN 1004  STATISTICS & COMPUTER FUNDAMENTAL

Total Marks : 100
Theory : 90
Int. ass. : 10
Teaching Hours : 60
Time : 3 Hours

Objective
To introduce students about basic concepts of Biostatistics including Distributions and Probability and also Introduction to computers and their Systems/Storage.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

Statistical Methods

UNIT I

Introduction to biostatistics, types of data, methods of data collection, classification and tabulation of data. Diagrammatical and graphical representation of data, frequency distribution, cumulative frequency distribution and their graphical representation, histogram, frequency polygon, frequency curve and ogives.

Concept of Central tendency and their measures, partitioning values; quantiles, deciles and percentiles, dispersion and their measures, relative dispersion. Central and non-central moments. Skewness, kurtosis and their measures, Box and whisker plot.
UNIT II
Basic concepts of probability theory, Baye’s theorem and conditional probability. Random Variables (discrete and continuous), probability mass function, probability density function, cumulative distribution function and their properties.
Mathematical expectation (single and bivariate), expectation of sum of random variables, Variance and Covariance, moment generating and probability generating functions.
Uniform, Bernoulli, Binomial and Poisson distributions and Normal distributions. Fitting of binomial, poisson and normal distributions.

Computer fundamentals

UNIT III
Computers: General introduction to computers, organization of computers, digital and analogue computers, computer algorithms.
Introduction to computers and its uses: milestones in hardware and software – batch oriented / online/realtime applications
Computers as a system: Basic concepts, stored programs, functional units, and their interrelation: communications with computer.

UNIT IV

Recommended books:
1. Introductory probability and statistical applications, P.L. Meyer, 1970
5. Introduction to Biostatistics (1973) Sokal & Rohif – Toppan Co Japan

BIN 1054 STATISTICS & COMPUTER FUNDAMENTALS (PRACTICAL)
Max Marks :50 (45+5)
1. Presentation of data by frequency tables, diagrams, graphs
2. Calculation of measures of central tendency
3. Calculation of measures of dispersion
4. Calculation of measures of skewness and kurtosis
5. Fitting of binomial distribution
6. Fitting of Poisson distribution
7. Probability
8. Basics of computer
9. Basic commands – File creation, Copying and deleting in Linux and Windows
10. Using Email, Browsers, Search Engines
BIN 1005   PHYSICS (BASIC AND APPLIED)

Total Marks: 100
Theory : 90
Int. ass. : 10
Teaching Hours : 60
Time : 3 Hour

Objective
The basic concepts of physics and their application are covered which are fundamental to understanding some biological phenomena.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I
Mechanics
Cartesian and spherical polar co-ordinate systems, area, volume, velocity and acceleration in these systems. Solid angle, centre of mass, equivalent one body problems, central forces, equation of motion under central force, Elastic collision, and C.M. system, velocities, angles and energies, principal moments and axes, Euler’s equations.

UNIT II
Vibration
Simple harmonic motion, energy of a SHO, transverse vibrations of a mass on a string. Decay of free vibrations due to damping. Differential equation for a forced mechanical and electrical, oscillators, transient and steady state behaviours. Displacement and velocity variation with driving force frequency, variation of phase with frequency, resonance, power supplied to an oscillator and its variation.

UNIT III
Electricity and Magnetism
Basic Ideas of vector calculus, gradient, divergence, curl and their physical significance (Qualitative only). Laplacian in rectangular, Coulomb’s law for point charges and continuous distribution of charges, electric field due to dipole, line charge and sheet of charge, Electric flux, Gauss’s law and its applications.
Work and potential difference as line integral of field, electric potential due to a point charge, a group of point charges, dipole moments, long uniformity charge wires, charge discs. Stoke’s theorem and its application in electrostatic fields.
Current and current density, equation of continuity, deviation of ohm’s law (J=εE), permeability and susceptibility and their inter relationships. Orbital motion of electron spin and paramagnetism, ferromagnetism, domain theory of ferromagnetism, Hysteresis loss (Qualitative only), magnetization curve, ferrites.
UNIT IV

Electrical circuits: Lorentz’s force, Biort Sovert’s law and its application to long straight wires, circular current loops and solenoid divergence and curl of B. Farady’s law of EM induction, Maxwell’s equation. Mutual inductance and Reciprocity theorem, Self Inductance L for solenoid, coupling of electrical circuits, Analysis of LCR series and parallel resonance circuits, Q factor, power consumed, power sector.

Recommended books:

BIN: 1055 PHYSICS (BASIC AND APPLIED) (PRACTICAL)

Max Marks :50 (45+5)

1. To study the dependence of MOI on distribution of mass by noting the time periods of oscillation
2. To determine energy transfer of coefficient of restitution and verify laws of conservation, linear momentum and kinetic energy in elastic collision using one dimensional collision of hanging spheres.
3. Using compound pendulum measure time period as a function of distance of centre of suspension (oscillation) from centre of mass, plot relevant graphs, determine radius of gyration and acceleration due to gravity
4. To study the magnetic field produced by a current carrying solenoid using a search coil and calculate permeability of air.
5. Study of phase relationships using impedance triangle for LCR circuit and calculate impedance.
6. Capacitance by flashing and quenching of a neon lamp.
7. To determine L using Anderson’s bridge.
8. To trace B-H curve for different materials using the CRO and find magnetic parameters from these.

Recommended Books:
1. D.P Khandelwal – A laboratory manual of physics for undergraduate classes
2. B.Sc Practical Physics by C.L Arora.
Objective

To introduce basic concepts of “C” Language, which is required to do programming and solve problems related to Bioinformatics.

Instructions for the paper-setters and Candidates

Note:

1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I

Introduction to Programming


Algorithms for Problem Solving

Exchanging values of two variables, summation of a set of numbers, Decimal Base to binary Base Conversion, reversing digits of an integer, GCD (Greatest Common Division) of two numbers, Test whether a number is prime, Organize numbers in ascending order, Find square root of a number, factorial computation, Fibonacci sequence, Evaluate ‘sin θ’ as sum of a series, Reverse order to elements of an array, find largest number in an array, print elements of upper triangle matrix, multiplication of two matrices, evaluate a polynomial.

UNIT II

Introduction to ‘C’ Language

Character set, variable and Identifiers, Built-in data types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement

Simple ‘C’ Programs

Conditional statement and Loops

Decision making with a program
Conditions, relational Operators, Logical connectives
If Statement, If-else statement
Loops : while loop, do while for loop, Nested loops, minus loops, Switch statement, structural programming
UNIT III

Arrays
One dimensional arrays, Array manipulation; Searching, Insertion, Deletion of an element from an array. Finding the largest/smallest element in an array.; Two dimensional arrays, Addition / Multiplication of two matrices, Transpose of a square matrix, Null terminated strings as array of characters, Representation sparse matrices.

Functions
Top-down approach of problem solving, Modular programming and functions,
Standard library of C functions, Prototype of a function: Formal parameter list, Return Type functionCall, Block Structure, Passing arguments to a function: Call by reference, call by value, Recursive functions, Arrays as function arguments

UNIT IV

Structure and Unions
Structure variables, initialization, structure assignment , nested structure, structures and functions, structures and arrays, arrays of structures, structures containing arrays,unions

Pointers
Address Operators, Pointer type declaration, pointer assignment , pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, Pointer arrays

File Processing
Concept of Files, Files operating in various modes and closing of a file, Reading from a file, writing on to a file.

Recommended books:


BIN 1056  ‘C’ PROGRAMMING  (PRACTICAL)

Max Marks :50 (45+5)

1. Write a program to Fibonacci series and factorial
2. Write a program to calculate a prime number even and odd numbers
3. Write a function to read a matrix of size m x n from the keyboard
4. Write a program to add and subtract a two-three matrix simultaneously
5. Write a program to print the following output using for loops
6. Programming problems on Arrray, Pointer and Files
Objective
Introduction to Biochemistry and Bioinformatics exposes the students to study chemistry of biomolecules and their integration in information technology which is the basis of Bioinformatics.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT - I

Chemical Foundations:
Water. Chemistry of water, ionization of water, equilibrium constant and concepts of weak acid and base, pH, pl, pKa, Henderson-Hasselbach equation and concepts of buffers in biology in brief.


UNIT – II

Introduction to Proteins & Protein Structure: Primary, Secondary, Tertiary and Quarternary Structure.

Enzymes:
General properties, specificity, classification, efficiency, regulation of enzyme activity (rate, concentration, time, pH, temperature), enzyme kinetics—rate equations, steady state, Michaelis – Menten equation.

Carbohydrates. Definition, classification and structure of monosaccharides, Disaccharides, polysaccharides, and glycoconjugates—proteoglycans, glycoproteins and glycolipids. Structural and functional roles of carbohydrates.
UNIT - III

**Sequence databases:** Primary and secondary databases, Nucleotide sequence database, nucleotide sequence flat files.

**Protein sequence databases:** Genpept, Uniprot, Swissprot, PIR, Sequence formats: Genbank, FASTA, ASN.

Information retrieval from biological databases. The NCBI resource, Entrez, Pubmed, Medline. Entrez Boolean search terms and statements. Locuslink, NCBI bookshelf.

UNIT - IV

**Sequence Alignment:**
Pairwise sequence alignment, Global alignment, Local alignment, Scoring functions and matrices, General gap and affine gap penalty, Statistical significance.

**Multiple Sequence alignment:** SP (Sum of Pairs) measure, Star alignments, Tree alignments, Motifs and Profile, Alignment representation and Applications, ClustalW, ClustalX and T-coffee.

**Recommended Books:**

BIN-1057 INTRODUCTION TO BIOCHEMISTRY & BIOINFORMATICS – PRACTICAL

Max Marks: 50 (45+5)

1. Verification of Beer Lambert law for p-nitrophenol or cobalt chloride
2. Determination pKa value of p-nitrophenol
3. Estimation of carbohydrate in given solution by Anthrone method
4. Protein estimation by Lowry’s method
5. Separation of lipids by Thin layer chromatography
6. Understanding and using Sequence information resources on web:
   EMBL, Genbank, Entrez
7. Understanding and using Protein information resources on web:
   PDB, Swissprot, TrEMBL
8. Using BLAST and Interpretation of results
9. Multiple sequence alignment using ClustalW
Outlines of Courses for B.Sc. (Hons.) Bioinformatics 2nd Year

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Subject</th>
<th>Lectures / week</th>
<th>Max Marks</th>
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<tr>
<td>BIN-2001</td>
<td>Fundamentals of Molecular Biology and Genetic Engineering</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-2002</td>
<td>Computational Methods in Bio-molecular Sequence Analysis</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-2003</td>
<td>Object Oriented Programming in C++</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-2004</td>
<td>Computer Operational System and Organization</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-2005</td>
<td>Statistical Methods</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-2006</td>
<td>Physical Chemistry</td>
<td>6</td>
<td>90+10=100</td>
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<tr>
<td>BIN-2051</td>
<td>Fundamentals of Molecular Biology and Genetic Engineering (Practical)</td>
<td>3</td>
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</tr>
<tr>
<td>BIN-2052</td>
<td>Computational Methods in Bio-molecular Sequence Analysis (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<tr>
<td>BIN-2053</td>
<td>Object Oriented Programming in C++ (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<tr>
<td>BIN-2056</td>
<td>Physical Chemistry (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<tr>
<td>BIN-2057</td>
<td>Project Work</td>
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<td>90+10=100</td>
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</table>

Total = (Theory + Practical) = 600 + 300 + 100 = 1000
Objective  
The Contents are related to the fundamental of molecular biology and their application in recombinant DNA technology.

Instructions for the paper-setters and Candidates  
Note:  
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.  
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.  
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.  
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I  
Introduction to Molecular Biology:  
Properties of DNA polymerases, Synthesis of Leading and lagging strands  
DNA Repair: Photo-reactivation, excision repair, post replication repair, SOS repair etc.

UNIT II  
Transcription: RNA polymerase in prokaryotes – its molecular composition, role of each component of RNA polymerase, mechanism of transcription, Eukaryotic transcription  
Regulation of gene expression in prokaryotes: Transcriptional control; enzyme induction and repression, constitutive synthesis of enzymes and catabolite repression. The lac operon. The trp operon.

UNIT III  
Translation: The genetic code. Prokaryotic and Eukaryotic Translation  
Modification of RNA: 5’ – CAP formation, 3’ – end processing polyadenylation, Splicing, Editing, Nuclear export of mRNA & mRNA stability

UNIT IV  
Recombinant DNA: History and scope of recombinant DNA technology  
DNA modifying enzymes  
Cloning and expression vectors:  
Characteristics of cloning and expression vectors; plasmid, phages, and cosmid vectors, multipurpose cloning vectors, shuttle vectors, bacterial, yeast, plant and mammalian expression vectors. BACs and YACs.  
DNA cloning strategies  
Preparation of genomic and cDNA libraries.
Recommended Books:

BIN-2051    FUNDAMENTALS OF MOLECULAR BIOLOGY AND GENETIC ENGINEERING (PRACTICAL)
Maximum Marks: 50 (45+5)

1. Isolation of Genomic DNA and Quantization of DNA
2. Isolation of bacterial plasmid DNA
3. Agarose gel electrophoresis of DNA
4. Restriction digestion of DNA with one restriction enzyme
5. Southern blot hybridization with non radioactive probe
6. Microscopy, chromosome staining
7. RFLP
8. PCR

BIN 2002    COMPUTATIONAL METHODS IN BIOMOLECULAR SEQUENCE & STRUCTURE ANALYSIS
Total marks: 100
Theory : 90
Int. Ass. : 10
Teaching Hours : 60
Time : 3 Hours

Objective
In this paper, sequence analysis of nucleotides & proteins and structure of protein using various computational tools which are important to study conservation in different species and establish phylogeny & homology is covered.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.
UNIT I
Scoring matrices: Protein and nucleotide scoring matrices i.e. PAM, BLOSUM, Gonett. How to construct scoring matrices. Difference between PAM and Blosum.

Database homology search: Concepts behind
BLAST: Applications & Biological Significance; homology, similarity & identity
Statistical significance of BLAST: E value, Scores
BLAST versions- BLASTp, BLASTn
Difference between FASTA and BLAST

UNIT II
Phylogenetic analysis: Basic terminology in Phylogenetics
Distance and parsimony methods; Clustering methods.
Rooted and unrooted trees. Brief introduction to Bootstrapping & Jackknifing, Introduction to Phylip and PAUP packages.

UNIT III
Predictive methods using DNA sequences

UNIT IV
Protein Structure Prediction
Secondary structure prediction methods: CHAU FASMAN, GOR, NN
Tertiary Structure prediction methods- Homology Modeling, Threading/Fold recognition and Abinitio.

Recommended books:
BIN-2052  COMPUTATIONAL METHODS IN BIOMOLECULAR 
SEQUENCE ANALYSIS (PRACTICAL)  
Maximum marks 50(45+5)

1. BLAST page at NCBI and its features
2. BLASTp and BLASTn analysis and data interpretation: E value, Scores

Building Phylogenetic trees using Phylip:
3. Distance based method
4. Character based method

Gene Prediction Tools:
5. GenScan
6. Glimmes

Protein Structure Modeling Using:
7. SPDB viewer
8. Modeller

BIN 2003  OBJECT ORIENTED PROGRAMMING in C++ 

Total Marks: 100
Theory  :  90
Int. Ass. : 10 
Teaching Hours : 60
Time     : 3 Hours

Objective
To introduce students about object oriented programming in C++ which is helpful in writing programmes to solve the problems in Bioinformatics.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I
Methodologies: Concept of structured and object-oriented programming Advantages of OOPs methodologies.


UNIT II
Operator overloading and Function overloading, Inheritance: Extending classes, Types of inheritance, Virtual base class, Problems with multiple inheritance, Containership, Virtual function, Polymorphism : Compile and Runtime, Pure Virtual Function.
UNIT III

Files and streams building class Libraries in C++, File Handling in C++, Template class and function, Exception Handling.

UNIT IV

Introduction to data structures like Arrays and Link-list and their implementation, Data Searching and Sorting algorithms.

Recommended Books:
3. The C++ Programming Languages by Stroustrup, Addison Wesely, 2001
6. Data structures by Tanenbaum, PHI, 1997

BIN 2053 OBJECT ORIENTED PROGRAMMING IN C++ (PRACTICAL)

Maximum Marks: 50 (45+5)

1. Write a program to find sum of digits of a number.
2. Write a program to calculate average of first ‘n’ numbers.
3. Program to search a given number from a given list of numbers entered using linear search.
4. Program to calculate area of a rectangle using classes.
5. Create a class employee and calculate gross salary. Demonstrate how private member functions can be accessed within a class.
6. Write a program to add, subtract, multiply and divide two complex numbers using classes.
7. Create a student class with following data members-Roll number, marks in three subjects(100 each) and member functions- for reading data, computing average an displaying the result of the student.
8. Create a class account that stores the account number and balance amount of the depositor. Also create the member functions to assign initial values, to deposit, to withdraw an amount after checking the balance and finally display the balance.
9. Write a program to illustrate the concept of overloaded constructors.
10. Write a program to show when a copy constructor is called.
11. Write a program to overload binary + operator using a member function.
12. Program to concatenate two string objects by overloading the + operator.
13. Write a program to demonstrate the concept of multiple inheritances.
14. Write a program that implements run time polymorphism using virtual function.
15. Program to illustrate how an exception is handled using try-catch block and throw statement.
Objective
To make students familiar with Evolution of Computers, Organization of Computers, Concepts of
Assembly language and System maintenance.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I
Computer Organisation:
Evolution of computers, stored program concept and Von Neumann Architecture, Information representation and codes, Building blocks and computer;
Combinatorial Block:
Gates, Multiplexes, decoders, Encoders etc. Sequential Building Block: Flip Flop, Registers, Counters, Random access memory; Register Transfer Language and micro-operations; concept of Bus, data movement among registers, Language to represent conditional data transfer, data movement from/to memory, Arithmetic and logical operations along with register transfer.

UNIT II
Architecture of a simple processor:
A simple computer Organization and instruction set, instruction execution in terms of Microinstructions, Concepts of interrupt and simple I/O organization, Implementation of the processor using building blocks; CPU organization with large registers, stacks and handling of interrupts and subroutines, instruction pipelining.

UNIT III
Concepts of Assembly Language Programming:
Machine and assembly language, Pseudo operations, subroutines in assembly language, interrupt and I/O programming

UNIT IV
I/O Organization:
Handshake based communication, vector and priority interrupts, DMA based data transfer; memory Organisation: basic cell of static and dynamic RAM, building large memories using chips associative memory, Cache memory organization, Virtual memory organization.
System Maintenance:
Introduction to various physical components of a computer, Physical Inspection of a PC and internal cards, Diagnostics on a PC, Functional description of various modules and cards. Various types of display and other peripherals used in a PC. Installing a software. Detection of viruses and protection on a PC.

Recommended Books:

BIN 2054 COMPUTER OPERATIONAL SYSTEM AND ORGANIZATION (PRACTICAL)  
Maximum marks 50 (45+5)

Part I: Studying various physical components of computer system

1. Study of system configuration (System settings)
2. Inspection and functional description of hardware components
   - I/O Devices: Monitor, Keyboard, Mouse, Speaker, Printer, Microphone, Scanner
   - Memory: Primary – RAM, BIOS ROM
     Secondary- Hard Disk (HDD), CD Drive, Floppy Disk (FDD)
   - Mother board with Add on (Internal) cards
   - BUS: PCI, ISA etc.
     Parallel and Serial Transfer

Part II: Installing a Software
1. MS DOS: Commands, Formatting, Partitioning of Hard disk, Booting, Starting system with bootable disk
2. Installation of Software:
   - Windows operating system
   - MS office, Antivirus, Photoshop, C/C++ and other utility software
   - Adding / Removing new hardware devices (device drivers detection and installation)

Part III: System Maintenance
1. Disk Utilities: Defragmentation, Scanning
2. System Protection: Anti virus check for system; fixed and removable disk
3. Diagnostics on a PC
4. PC Troubleshooting
Objective

To study the concepts of correlation, Regression, Estimation and Testing of parametric and non-parametric Hypotheses.

Instructions for the paper-setters and Candidates

Note:

1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I

Bivariate data, scattered diagram, Karl Pearson’s and Spearman’s rank correlation coefficient. Linear regression analysis including two variables.

UNIT II

Sampling distributions, Estimation of population means and proportions, confidence intervals for the parameters of normal distribution under different conditions (two sample problems also). Determination of sample size for estimating means and proportions.

UNIT III

The basic idea of significance test. Tests of hypotheses for the parameters of a normal distribution (two sample problems also). Tests for the significance of correlation coefficient. Categorical data: Proportions and their testing for large samples, Tests of association, goodness-of-fit using Chi-square test, Yates correction.

UNIT IV

Analysis of variance, one-way and two-way classifications. Brief exposure of three basic principles of design of experiments, treatment, plot and block. The analysis of completely randomized design, randomized complete Block Design. Introduction to non-parametrics : Sign test, Wilcoxon signed-rank test and mann-whitney test.

Recommended Books:

BIN 2055  STATISTICAL METHODS (PRACTICAL)

Maximum marks 50 (45+5)

1. Practical Problems based on correlation coefficient, spearman’s rank correlation
2. Problems based on simple regression
3. Practical based on z- test and t-test (i.e. Testing of Mean in both cases when variance is known and when variance is unknown (one sample problem). Also to find the confidence interval of population mean.
4. Practical based on testing of single proportion and difference of proportions
5. Practical on association
6. Practical on Chi-square test of goodness of fit.

BIN 2006  PHYSICAL CHEMISTRY

Total Marks: 100
Theory : 90
Int. ass. : 10
Teaching Hours : 60
Time : 3 Hours

Objective
The knowledge of techniques and principles of physical chemistry is required to study biomolecules and understanding their properties.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type(containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I

UNIT II
Solutions, Colligative properties, raoults law, thermodynamics of Freezing point depression, elevation in boiling point.
Acids and Bases, pH, buffer action, pK. Acids and Bases strengths, acidity and basicity of solvents. Acid-base reaction
Electrochemistry and Redox reactions: Half-reactions, oxidation/reduction potential, electrochemical cell, reversibility, reference electrodes, Nernst equation, chemical potential from Nernst equation.

UNIT III
Chemical Kinetics. Basic definitions, differential equation of rate. Rate constants, rate laws, 1st and 2nd order kinetics, maths of determination of kinetics from rate laws, half-life. Empirical determination of reaction order and reaction kinetics; initial rates, kinetic analysis, experimental methods, reversible 1st order equilibria: \( K = k_1/k_{-1} \), relation to \( \Delta G \).
Theories of reaction rates, collision theory, transition state theory of biomolecular processes.

UNIT IV
Molecular Spectroscopy: Differences between Atomic and molecular spectroscopy. Absorption and emission spectroscopy. Wavelength and relative energies.
UV/Vis spectroscopy: Beer Lambert's law, extinction coefficients.
Photochemistry: Photochemical principles, Quantum yield, Fluorescence and phosphorescence.
IR spectroscopy: The theory of stretching and bending modes, the selection rules and how to use them to predict number of IR active bands.
Raman spectra- brief introduction. Rotational Raman and Rotational Vibrational spectra.
Magnetic resonance spectroscopy: NMR - Basic concepts including chemical shifts and coupling.
Differences between NMR and ESR. Applications.

Recommended Books:

BIN: 2056 PHYSICAL CHEMISTRY (PRACTICAL)

Maximum marks 50 (45+5)
1. Study of distribution law by iodine distribution between water and CCl₄. Given standard solution Na₂S₂O₅.
2. Determination of adsorption isotherm of oxalic acid on charcoal.
3. Surface tension: Determination of surface tension of a given liquid by Stalhmimeter.
5. Refractometry: Determine refractive index of a given liquid as a criterion for its purity (Benzene i.e. commercial) benzene + A.R. acetone.
6. **Polarimetry:** Determination of the percentage composition of and optically active solution.

7. **Conductometry:**
   (a) Determination of cell constant
   (b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl)
   (c) pH of buffer solution
   (d) Acid base titration of HCl Vs NaOH
   (e) Determination of ionization of a weak acid (CH$_3$COOH)

**BIN: 2057  PROJECT WORK  Maximum Marks: 100 (90 + 10)**

Project work to be carried out by the students pertaining to syllabi of Bioinformatics.
## Outlines of Courses for B.Sc. (Hons.) Bioinformatics III Year

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Subject</th>
<th>Lectures / week</th>
<th>Max Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIN-3001</td>
<td>Introduction to PERL Programming</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3002</td>
<td>Fundamentals of Genomics</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3003</td>
<td>Introduction to Proteins and Proteomics</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3004</td>
<td>Genetics &amp; Evolution</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3005</td>
<td>Biochemical and Molecular Biology techniques</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3006</td>
<td>Cell Biology &amp; Immunology</td>
<td>6</td>
<td>90+10=100</td>
</tr>
<tr>
<td>BIN-3051</td>
<td>Introduction to PERL Programming (Practical)</td>
<td>3</td>
<td>45+5=50</td>
</tr>
<tr>
<td>BIN-3052</td>
<td>Fundamental of Genomics (Practical)</td>
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<td>BIN-3053</td>
<td>Introduction to Proteins and Proteomics (Practical)</td>
<td>3</td>
<td>45+5=50</td>
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<td>BIN-3054</td>
<td>Genetics &amp; Evolution (Practical)</td>
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<tr>
<td>BIN-3056</td>
<td>Cell Biology &amp; Immunology (Practical)</td>
<td>3</td>
<td>45+5=50</td>
</tr>
<tr>
<td>BIN-3057</td>
<td>Project Work</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

Total = (Theory + Practical) = 600 + 250 = 1000
BIN-3001 INTRODUCTION TO PERL PROGRAMMING

Total marks: 100
Theory : 90
Int. ass.: 10
Teaching Hours : 60
Time : 3 Hours

Objective
Since Bioinformatics relies highly on Biological database and introduction to PERL Programming is necessary for better understanding the architecture of databases.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting at least one question from each unit.
4. The questions (2-8) may be divided into at least two parts and each question (2-8) will carry equal marks.

UNIT I
Introduction to PERL
What is PERL; Comparison with other languages like JAVA, C, PHP, Python; Install PERL on Windows and UNIX environment; Installing PERL modules; Writing and running a PERL script; Numeric data and string literals; How to store string/numbers in variables; Input/output variables;

UNIT II
Concept of Programming
Operators (Unary, Binary, Multiplicative, Conditional, logical etc.); Control Statements (IF, DO, WHILE, FOR); Defining and calling functions; List Processing; Arrays handling; Input from command (ARGV, ARGC); Reading values from file and screen; Writing/appending in files.

UNIT III
Pattern Matching
Manipulation of strings; Regular expressions; Pattern-Matching Operators; Standard Modules; Subroutines; Using system command; Important functions (split, index, substr, chomp, length, reverse, shift, sort)

UNIT IV
Perl and Internet
Introduction to TCP/IP protocol; Internet applications; HTML and submission forms; installation/configuration of Apache; Common Gateway Interface (CGI); Reading and processing HTML forms; using perl with web servers.

Reference Books:
1. Programming Perl, Third Edition By Larry Wall, Tom Christiansen, Jon Orwant
   July 2000. O’Reilly
BIN- 3051     INTRODUCTION TO PERL PROGRAMMING – PRACTICAL

Max.Marks 50 (45+5)

1. Write a script code to illustrate “while” and “do” operator
2. Write a script code to illustrate use of Arithmetical and String operators
3. Write a Perl script that declares three arrays and assigns lists to them
4. Write a code to show ascending and descending sorting
5. Write a script code that read a HTML form via CGI

BIN-3002                     FUNDAMENTALS OF GENOMICS

Total Marks: 100
Theory :  90
Int. Ass. : 10
Teaching Hours :  60
Time : 3 Hours

Objective
The fundamentals of genomics dealing with gene structures and elements are covered.

Instructions for the paper-setters and Candidates

Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
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4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I


UNIT II


Genome Sequencing methods: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.
UNIT III

**Polymorphisms:** Repeats and Single Nucleotide Polymorphisms (SNPs), SNP detection methods: SSCP, PCR-based, dHPLC sequencing, SNP and disease.

**Molecular markers:** RFLP, VNTR, RAPD, SSR, AFLP

UNIT IV

**Managing and Distributing Genome Data:** Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organismal Genomes and Databases.

**Reference Books:**

### BIN-3052 FUNDAMENTALS OF GENOMICS (PRACTICAL)

Max. Marks 50 (45+5)

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. NCBI Genome site
4. Detection of Open Reading Frames using ORF Finder
5. Use of Saccharomyces Genome Database (SGD)
6. Repeat masking software tool

### BIN-3003 INTRODUCTION TO PROTEINS AND PROTEOMICS

Total Marks: 100
Theory : 90
Int. Ass. : 10
Teaching Hours : 60
Time : 3 Hours

**Objective**
Sequence Analysis of proteins is integral to Bioinformatics and therefore introduction to the proteins and the concepts will help students to apply bioinformatics tools on biological data.

**Instructions for the paper-setters and Candidates**
**Note:**
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
3. The candidates will be required to attempt five questions in all by selecting atleast one question from each unit.
4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT - I

**Proteins:** Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.

UNIT - II

**Proteins:** Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT - III

**Post Translational Modifications of Proteins:** Glycosylation, phosphorylation, lipid attachment, disulphide bond formation.
Proteolytic processing. Protein localization and topology: Membrane proteins, secreted proteins, ER/ GOLGI, Mitochondrial, chloroplast and nuclear localization of proteins.
Non-ribosomal synthesis of peptides with examples.

UNIT - IV

**Introduction to Proteomics.** The proteome. Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.
Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data.

**Recommended Books:**

**BIN-3053 INTRODUCTION TO PROTEINS AND PROTEOMICS (PRACTICAL)**

Max. Marks 50 (45+5)

1. Proteomics 2D PAGE database
2. Softwares for Protein localization – PSORT2
3. Hydropathy plots
4. Native PAGE
5. SDS PAGE
**Objective**

*Introduction to the Principles of genetics will help students to acknowledge the phenomena which results in gene diversity and evolution.*

**Instructions for the paper-setters and Candidates**

**Note:**
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
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**UNIT I**

*Mendel’s work* - modified mendelian ratios, epistasis, incomplete dominance, multiple alleles, lethal genes, penetrance, expressivity, pleiotropy.

**UNIT II**

*Structure and organization of eukaryotic genome –* Chromosomal DNA, its packaging, polytene and lampbrush chromosomes.

Chromosome theory of inheritance- Cell division, linkage, crossing over, recombination, genetic mapping- chromosome mapping, gene mapping, X-inactivation, sex linked inheritance, mitochondrial inheritance.

**UNIT III**

*Phage lambda genetics* - gene organization of phage lambda, lytic cycle, lysogenic cycle.

*Mutagenesis in Bacteria* - types of mutants, mutagenic agents, isolation and characterization of mutants, reversion, suppression, transposable elements.

**UNIT IV**

*Quantitative Genetics and Population Genetics* : Qualitative vs. Quantitative traits.


**Reference Books:**

1. Demonstration of Law of Segregation (use of coloured beads, capsules)
2. Demonstration of Law of Independent assortment (use of coloured beads, capsules)
3. Calculation of variance in respect of pod length and numbers of seeds/pods.
4. Calculation of gene frequencies (use of coloured beads, capsules)
5. Preparation and study of mitosis and meiosis slides.

Objective
Biochemical and Molecular Biology techniques are taught to students so that they are aware of the principles, protocols/methodology involved in the generation of wet lab experimental data and its interpretation.

Instructions for the paper-setters and Candidates
Note:
1. Nine questions will be set in all, uniformly distributed over the entire syllabus i.e. two from each unit.
2. Q. No. 1 will be of objective type (containing 9 parts of 2 marks each) covering the entire syllabus will be compulsory.
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4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I

UNIT II
Microscopy: Light Microscopy, Phase contrast microscopy, Electron Microscopy, Confocal Microscopy, Fluorescence microscopy. Flow Cytometer (Fluorescence assisted cell sorting)

UNIT III
Chromatography: definition and principles and types- paper, thin-layer, adsorption, gas, Reverse phase chromatography and HPLC.
Principles and techniques of protein purification: ion-exchange, affinity, gel-filteration.
UNIT IV

Biochemical Methods of Analysis
Electrophoresis: Principles, types- moving, paper, starch gel, agar gel, immunoelectrophoresis, Isoelectric focusing.
Colorimetry, Fluorimetry and Spectrometry: Principle of Beer and Lambert’s Law, description and application.
Centrifugation, Ultracentrifugation for protein and nucleic acids preparation and fractionation.

Recommended Books:

BIN-3055 BIOCHEMICAL AND MOLECULAR BIOLOGICAL TECHNIQUES-PRACTICAL

Max. Marks 50 (45+5)

1. Polymerase chain reaction
2. Southern Blotting
3. Principles of compound, phase contrast, electron microscopy
4. Use and care of light compound microscope
5. Verification of Beer and Lambert’s law using CoCl₂.5H₂O (in water) and K₂Cr₂O₇ in water
6. Thin Layer Chromatography
7. Paper Chromatography
8. Agarose Gel Electrophoresis
9. SDS PAGE
10. Differential Centrifugation
Objective
Cells & immune system involve interaction of various bio-molecules resulting in normal functions or various pathophysiological conditions. So the students are exposed to the underlying concepts and phenomena of Cell Biology & Immunology.

Instructions for the paper-setters and Candidates
Note:
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4. The questions (2-8) may be divided into atleast two parts and each question (2-8) will carry equal marks.

UNIT I

UNIT II
 Trafficking of proteins. Trafficking in the secretory pathway: ER, Golgi, lysosome, cell membrane. Retention signals in the ER, sorting signals to the lysosome. Vesicular budding and fusion. Role of SNAREs. Phagocytosis, Receptor mediated Endocytosis of biologically important molecules, toxins. Importance of endosome in endocytosis Trafficking to the chloroplast and mitochondria

UNIT III
Immune system: humoral immunity Introduction, Lymphocytes: their origin and differentiation, Types of immune responses B-lymphocytes and their activation, structure and function of immunoglobin, immunoglobin classes and subclasses, generation of antibody diversity, major histocompatibility complex.

UNIT IV
Immune System: Cellular Immunity: Thymus derived lymphocytes (T cells) and their classification, Antigen presenting cells (APC), Macrophages, langerhans cells their origin and functions, mechanisms of
phagocytosis, Identification of cell type of immune systems, immunosupression, immune tolerance, Monoclonal antibodies. Stem Cells.

Reference Books:

BIN-3056 CELL BIOLOGY & IMMUNOLOGY (PRACTICAL)
Maximum Marks 50 (45+5)

1. TLC and DLC for Blood samples
2. Determination of cell number (viable/non-viable)
3. Ficoll density gradient, separation of cell types
4. Cell agglutination reaction
5. SDS-PAGE
6. ELISA
7. Western Blot.

BIN – 3057 PROJECT WORK
Max. Marks: 100

Every student will submit a thesis report based on the work carried out under the guidance of Department faculty, pertaining to the syllabi of Bioinformatics. The report will be evaluated in terms of quality of written work, experimental and performance in the viva-voce by internal and/or external examiner(s).

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