GENERAL INSTRUCTIONS AND COURSE CURRICULUM

FOR

ONE YEAR

POST GRADUATE DIPLOMA
IN BIOINFORMATICS

(EFFECTIVE FROM JULY, 2018)

Bioinformatics Centre (Sub-DIC)
DEPARTMENT OF BIOTECHNOLOGY
HIMACHAL PRADESH UNIVERSITY,
SUMMER HILL, SHIMLA-171005.
1. The diploma course will be of one-year duration.

2. There will be two semesters. First semester will have four courses to be passed for completing the course. Courses I – III will be theory based, whereas Course IV will be practical based. Semester two will have project/dissertation.

3. The distribution of marks in theory, practical and dissertation/project are given along with.

4. The candidate who regularly attends teaching/practical classes and maintains 75% attendance in each of the courses/practicals shall be permitted to sit in the semester examinations.

5. Classroom Attendance Incentive: Those candidates who have greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to percentage attendance) will be awarded CAI marks as follows:

- \( \geq 75\% \text{ but } < 80\% \) 1 marks
- \( \geq 80\% \text{ but } < 85\% \) 2 marks
- \( \geq 85\% \text{ but } < 90\% \) 3 marks
- \( \geq 90\% \text{ but } < 95\% \) 4 marks
- \( \geq 95\% \text{ to } 100\% \) 5 marks

6. Eligibility for admission will be Bachelor Degree under 10+2+3 pattern of Education in Sciences with any of the subjects i.e. Microbiology, Biochemistry, Biotechnology, Genetic, Molecular Biology, Botany, Zoology or MBBS/ B.V.Sc from any Institute/University recognized by the Himachal Pradesh University, Shimla/University Grant Commission, New Delhi with at least 50% marks (for SC/ST candidates, eligibility will be 45% marks or equivalent grade).

7. The candidate has to secure minimum pass marks (40%) individually in Theory paper, Practical as well as in viva to earn full credits in the concerned course. A candidate thus failing in any of these components shall be considered failed in that course.

8. The course fee for full course (two semester) shall be Rs.40,000/- besides Himachal Pradesh University fee, if any.
## OUTLINES OF THE ONE YEAR DIPLOMA COURSE IN BIOINFORMATICS

<table>
<thead>
<tr>
<th>Units</th>
<th>Title of course</th>
<th>Marks</th>
<th>Total Marks</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
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<tr>
<td>Semester I</td>
<td></td>
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<tr>
<td><strong>Course I (Basics of Biology)</strong></td>
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<tr>
<td>Unit I</td>
<td>Introduction to Microorganisms</td>
<td>70</td>
<td>zero</td>
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<tr>
<td>Unit II</td>
<td>Principles of Inheritance and Chromosomes</td>
<td></td>
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<tr>
<td>Unit III</td>
<td>Biological Chemistry of Nucleic Acids</td>
<td>70</td>
<td>zero</td>
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<tr>
<td>Unit IV</td>
<td>Biological Chemistry of Proteins</td>
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<tr>
<td>Unit V</td>
<td>Metabolism</td>
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<tr>
<td><strong>Course II (Statistical Methods in Bioinformatics)</strong></td>
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<tr>
<td>Unit I</td>
<td>Principles of Statistical Methods</td>
<td>70</td>
<td>zero</td>
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<tr>
<td>Unit II</td>
<td>Matrices and Variables</td>
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<tr>
<td>Unit III</td>
<td>Correlation and Regression</td>
<td>70</td>
<td>zero</td>
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<tr>
<td>Unit IV</td>
<td>Probability and Various Tests of Significance</td>
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<td>Unit V</td>
<td>Statistical inference and Analysis of Variance</td>
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<tr>
<td><strong>Course III (Database and Sequence Bioinformatics)</strong></td>
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<tr>
<td>Unit I</td>
<td>Introduction to Genomics &amp;Proteomics</td>
<td>70</td>
<td>zero</td>
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<tr>
<td>Unit II</td>
<td>Sequence Alignments and Tools</td>
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<tr>
<td>Unit III</td>
<td>Determining Homology</td>
<td>70</td>
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<tr>
<td>Unit IV</td>
<td>Phylogenetic Analysis</td>
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<tr>
<td>Unit V</td>
<td>Protein Modelling &amp; Drug Designing</td>
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<td><strong>Course IV (Practicals)</strong></td>
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<td></td>
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<td>Zero</td>
<td>100</td>
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<tr>
<td>Semester II</td>
<td></td>
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<tr>
<td>Project Report</td>
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<td>150</td>
<td>50*</td>
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COURSE I: BASICS OF BIOLOGY

Maximum marks: 70

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<td>30</td>
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Note: The Examiner will set a total of five (05) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the five questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

UNIT I

An introduction to microbial cell biology and cell architecture: Modern classification based on three domains of life: Archaeabacteria, Eubacteria and Eukaryota, bacterial cell wall, cytoplasmic membrane – structure and composition, peptidoglycan, pili, sex pili, flagella, glycocalyx, capsule and spores, chromosomes, extra chromosomal elements and plasmids. Salient features of Gram positive and Gram negative bacteria and archaeabacteria, pathogenic and beneficial microorganisms.

UNIT II


UNIT III

Biological chemistry nucleic acids: bases, nucleotides, RNA and DNA, different structural forms of DNA, denaturation, renaturation and hybridization of DNA, different types of RNA, protein-nucleic acid interaction.

UNIT IV

Proteins: amino acids and peptides, primary, secondary, tertiary and quaternary structures, structure, function and evolutionary relationships, protein-protein interactions, protein folding, allosteric proteins.

UNIT V

Metabolism: Pathways, shuttle pathways, energy charge, oxidation of glucose in cells, high energy bond, glycolysis, gluconeogenesis, ED, citric acid cycle and oxidative phosphorylation.

Suggested books

COURSE II: STATISTICAL METHODS IN BIOINFORMATICS

Maximum marks: 70

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UNIT I
Principles and practice of statistical methods of biological research, samples and populations; Measures of central tendencies: mean, mode, median and ogives, Measures of dispersion: range, standard deviation and variance.

UNIT II
Determinants: properties of determinants, Grammar rule. Matrices: types of matrices, addition, multiplication, inverse, solution of linear equation by matrix method. Integration: indefinite and definite integrals of functions of only one variable by method of substitution and integration by parts-simple cases.

UNIT III
Linear correlations: product moment coefficient of correlations, Spearman’s rank difference correlation methods; Regression analysis: simple regression, regression lines, regression equations, regression equations in case of correlation tables.

UNIT IV
Probability distribution: addition and multiplication theorems, Bayes theorem, Binomial, Poisson and normal distribution. Parametric tests: F & T-tests, $X^2$ test, $X^2$ test as a test of independence and goodness of test, experimental design.

UNIT V
Statistical inference: hypothesis testing, significance level, two-tailed and one-tailed tests of hypothesis. Test of significance: concept and basic terminology of large and small sample, means, and difference between means. Analysis of variance: assumptions, techniques of analysis of variance, analysis of variance in one-way techniques.

Suggested books

COURSE III: DATABASES AND SEQUENCE BIOINFORMATICS

Maximum marks: 70
Teaching hours: 45

Note: The Examiner will set a total of five (05) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the five questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

UNIT I
Introduction to databases: Primary and secondary databases, introduction to nucleotide sequencedatabases (DDBJ, EMBL, Genbank), RefSeq at NCBI and protein sequence databases (SWISSPROT, PIR, UNIPROT). Genomics: Introduction to nucleotide and protein sequence data formats: FASTA, Genbank flatfile. Genome Sequencing technology, whole Genome analysis and comparative analysis. Proteomics: Protein Information Resources (PIR), Entrez and SRS.

UNIT II

UNIT III
Notion of homology: Orthologues, paralogues, analogues, identity, homology & similarity with reference to evolutionary relationships. Similarity search: BLAST: concepts & algorithm, applications and significance, Salient features of various BLAST versions: BLASTp, BLASTn, BLASTx, tBLASTn, tBLASTx, PSI and PHI BLAST. FASTA & its algorithm.

UNIT IV
Phylogenetic Analysis: Evolutionary change in nucleotide sequence’s rates & patterns of nucleotide substitution. Branches, nodes, internal nodes, rooted & unrooted trees. Distance based methods (UPGA & NJ) and character based methods (Maximum Parsimony & Maximum Likelihood). PAUP, PHYLIP, Bootstrapping evaluation method.

UNIT V
Introduction to computer based drug designing, physiochemical parameters, QSAR. Molecular modeling: introduction, dynamic simulation, conformational search, molecular modeling packages (Chem3D, Hyperchem), protein modeling, structure prediction and molecular docking.

Suggested books
COURSE IV: PRACTICALS

Maximum marks: 100     Teaching hours: 45

Note: All practicals are to be performed and written in practical files

Lists of Practicals
1. Understanding and using of National Centre for Biotechnology Information (NCBI)
2. Understanding and using of Genbank
3. Understanding and using of ENTREZ
4. Understanding and using of SWISSPROT/TrEMBL
5. Understanding and using of UniProt (ExPASY)
6. Using Basic Local Alignment Search Tool (BLAST) & interpretation of its results
7. Multiple sequence alignment using Clustal Omega.
8. Phylogenetic analysis using MEGA or other software
9. Prediction of three dimensional structure using bioinformatics approach