GENERAL INSTRUCTIONS AND COURSE CURRICULUM

FOR

ONE YEAR

POST GRADUATE DIPLOMA

IN BIOINFORMATICS

(EFFECTIVE FROM JULY, 2018)

Bioinformatics Centre (Sub-DIC)
DEPARTMENT OF BIOTECHNOILOGY
HIMACHAL PRADESH UNIVERSITY,
SUMMER HILL, SHIMLA-171005.

(BIOINFORMATICS CENTRE)
HIMACHAL PRADESH UNIVERSITY
SUMMER HILL, SHIMLA-171 005 (H.P.), INDIA

GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM

1. The diploma coursewill be of one-yearduration.

2. There will be two semesters. First semester will havefour courses to be passed for completing the course. Courses I – III will betheory 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 alongwith.

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 per cent attendance) will be awarded CAI marks as follows:

$\geq 75\%$ but $< 80\%$	1 marks
$\geq 80\%$ but $<85\%$	2 marks
≥ 85 but $<90\%$	3 marks
$\geq 90\%$ but $< 95\%$	4 marks
$\geq 95\%$ 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

Units	Title of course	Marks			Total Marks
		Theory	**Practical**	**Internal assessment/ Viva***	
Semester I				
Course I (Basics of Biology)				
Unit I	Introduction to Microorganisms	70	zero	30	**100**
Unit II	Principles of Inheritance and Chromosomes				
Unit III	Biological Chemistry of Nucleic Acids				
Unit IV	Biological Chemistry of Proteins				
Unit V	Metabolism				
Course II (Statistical Methods in Bioinformatics)				
Unit I	Principles of Statistical Methods	70	zero	30	**100**
Unit II	Matrices and Variables				
Unit III	Correlation and Regression				
Unit IV	Probability and Various Tests of Significance				
Unit V	Statistical inference and Analysis of Variance				
Course III (Database and Sequence Bioinformatics)				
Unit I	Introduction to Genomics &Proteomics	70	zero	30	**100**
Unit II	Sequence Alignments and Tools				
Unit III	Determining Homology				
Unit IV	Phylogenetic Analysis				
Unit V	Protein Modelling & Drug Designing				
Course IV (Practicals)				
		Zero	100	zero	**100**
Semester II				
	Project Report	Zero	150	50*	**200**

COURSE I: BASICS OF BIOLOGY

Maximum marks:70   **Teaching hours:45**

T	P	IA
70	0	30

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: Archaebacteria, Eubacteria and Eukaryota, bacterial cell wall, cytoplasmic membrane – structure and composition, peptidoglycan, pili, sex pili, flagella, glycocalyx, capsule andspores, chromosomes, extra chromosomal elements and plasmids. Salient features of Gram positive and Gram negative bacteria and archaebacteria, pathogenic and beneficial microorganisms.

UNIT II

Chromosomes, cell cycle, mitosis, meiosis, structure of chromosomes. Mutations andthe sources of mutations. Spontaneous mutations and Induced mutations. Principles ofMendelian inheritance and chromosomal basis of inheritance.

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
1. Lewin's Cells by LynneCassimeris, Jones and Bartlett, 2nd Edition, (2011)
2. Cell Biology by G Karp, John Wiley and Sons, 7th Edition, (2014)
3. Biochemistry by DVoet, John Wiley and Sons, 4th Edition, (2013)
4. Biochemistry by Grisham & Garrett, Brooks/Cole, 4th Edition, (2010)
5. Evolution by W Monroe, Jones and BartlettPublishers.4rd Edition, (2008)

COURSE II: STATISTICAL METHODS IN BIOINFORMATICS

Maximum marks: 70   **Teaching hours: 45**

T	P	IA
70	0	30

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
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, Bionomial, 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

1. Statistical Methods in Bioinformatics: An Introduction by Ewens Warren J, Springer, 1st Edition, (2005)
2. Handbook of Statistical Bioinformatics by Lu Shing Henry Horng, Springer, 1st Edition, (2011)
3. Statistics for Biosciences by William P. Gardiner, Prentice Hall, 2nd Edition, (1997)
4. Fundamentals of Biostatistics by NK Dutta, Kanishka Publishers, 1st Edition (2002)

COURSE III: DATABASES AND SEQUENCE BIOINFORMATICS

Maximum marks: 70   **Teaching hours:45**

T	P	IA
70	0	30

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, Genbankflatfile.Genome Sequencing technology, whole Genome analysis and comparative analysis.Proteomics: Protein Information Resources (PIR), Entrez and SRS.

UNIT II

Sequence Alignment:Dotplot, advantages and disadvantages.Pairwise alignment: Local and Global alignment; Needleman and Wunsch algorithm, SmithWaterman algorithm; PAM & BLOSSUM matrices.Multiple Sequence Alignment: Consensus, Motifs. Application of multiple sequence alignment,use of Clustal omega and Clustal W, X for multiple sequence alignment.

UNIT III

Notion of homology: Orthologues, paralogues, analogues, identity,homology &similarity with reference to evolutionary relationships.Similarity search: BLAST: concepts & algorithm, applications and significance, Salientfeatures 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 desigining,physiochemical parameters, QSAR. Molecular modeling: introduction, dynamic simulation, conformational search, molecular modeling packages (Chem3D, Hyperchem), protein modeling, structure prediction and molecular docking.

Suggested books

1. Bioinformatics: Methods &Applications Genomics Proteomics and Drug Discovery by SC Rastogi, Prentice Hall Publication, 1st Edition (2011).
2. Introduction to Bioinformatics by Arthur M. Lesk, OUP Publications, 1st Edition (2014).
3. Bioinformatics and Functional Genomics by Pevsner Jonathan, Wiley Publications,3rd Edition (2015).
4. Introduction to Machine Learning and Bioinformatics by SushmitaMitra, CRC Press, 1stEdition (2015).
5. Bioinformatics Challenges: At the Interface of Biology and Computer Science by K Attwood, Wiley Publications, 1st Edition, (2016).
6. Multiple Biological Sequence Alignment by Ken Nguyen. Wiley Publications, 1st Edition, (2016)

COURSE IV: PRACTICALS

Maximum marks: 100   **Teaching hours: 45**

T	P	IA
0	70	30

Note: All practicals are to 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