# GUJARAT UNIVERSITY

## SYLLABUS

# Post Graduate Diploma in Bioinformatics

## Effective from July 2022

The **Post Graduate Diploma in Bioinformatics** course aims at equipping the learner with the basics and advanced aspects of the subject.

1. There will be 2 Papers (Three Hour Duration) and two Practicals (Six hour Duration) of One Hundred (70 External + 30 Internal) Marks each at Semester Examination.
2. Candidate shall be required to submit at the time of practical examination at the end of each semester.
   - ➢ The laboratory Journal and diary of lab work duly signed by the teachers concerned from time to time.

# Distribution of Marks

 **Internal**

| PGD - BIN | Per Paper / Marks | Total |
|---|---|---|
| Semester I | Paper 401 and 402<br>30 + 30 | 60 |
| Semester I Practicals | Paper 403 and 404<br>30 + 30 | 60 |
| Semester II | Paper 501 and 502<br>30 + 30 | 60 |
| Semester II Practicals | Paper 503 and 504<br>30 + 30 | 60 |

**EXTERNAL MARKS and total:**

| Semester | Theory / Project | | | Practical | | | Grand Total |
|---|---|---|---|---|---|---|---|
| | Internal | External | Total | Internal | External | Total | |
| I | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 400 |
| II | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 400 |
| | | | | | | | **800** |

# Seminar:
- Topics will be allotted in the beginning of the each semester.
- On due date student has to present the seminar on allotted topic and submit compiled literature.
- Presentation would be evaluated.
- Assignments and seminars are compulsory and marks would be added in Internal marks.

# COURSE STRUCTURE

| Department Name: Department of Botany, Bioinformatics & Climate Change Impacts Management, School of Sciences | | Semester - I | | | | | |
|---|---|---|---|---|---|---|---|
| Course | | Name of Course | No. of Hours per Week | | | | |
| No. | Type | | Lectures | Others | Practical | Total | Credit |
| PGD BIN 401 | CORE | BIOINFORMATICS FUNDAMENTALS AND BIOLOGICAL DATABASES | 3 | 2 | - | 5 | 5 |
| PGD BIN 402 | CORE | LINUX AND SYSTEM DEVELOPMENT | 3 | 2 | - | 5 | 5 |
| PGD BIN 403 | CORE | PRACTICAL | - | 2 | 3 | 5 | 5 |
| PGD BIN 404 | CORE | PRACTICAL | - | 2 | 3 | 5 | 5 |
| | | TOTAL | 06 | 08 | 06 | 20 | 20 |
| | | | Semester - II | | | | |
| Course | | NAME OF COURSE | No. of Hours per Week | | | | |
| No. | Type | | Lectures | Others | Practical | Total | Credit |
| PGD BIN 501 | CORE | GENOMICS AND PROTEOMICS | 3 | 2 | - | 5 | 5 |
| PGD BIN 502 | CORE | COMPUTATIONAL DRUG DISCOVERY AND PHARMACOGENOMICS | 3 | 2 | - | 5 | 5 |
| PGD BIN 503 | CORE | PRACTICAL | - | 2 | 3 | 5 | 5 |
| PGD BIN 504 | CORE | PRACTICAL | - | 2 | 3 | 5 | 5 |
| | | TOTAL | 06 | 08 | 06 | 20 | 20 |

**CREDIT AND EVALUATION SYSTEM:**

This Programme carries a **Total of 50 Credits**. Each of the above courses carries Four Credits (One Credit Equals 9 Hours Each).

Total Credits in each semester will be as under:

Number of courses in Semester-I x Credits for each course =4x5 =20 Credits

Number of courses in Semester-II Plus Credits for project Work =20 Credits

Plus Credits For Assignment, Documentation and Seminar in Semester-II =10 Credits

Total Credits for Semester-II = 30 Credits

Giving **Total Credits for entire programme =50 Credits**

- ➤ Minimum of 75% Attendance in each semester (135 Hours out of 180 hours (45x4 courses) in each semester i.e. a minimum of 15 Credits in each semester) is a mandatory requirement to qualify for the Internal and University Exams in each semester. Students not satisfying this criterion will disqualify for the Internal as well as Semester End University Exams.
- ➤ Each course in this P.G. Diploma carries 100 marks for the purpose of evaluation out of which 30 marks are allotted for internal evaluation and 70 marks are allotted for semester end University examination known as external evaluation.
- ➤ The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.
- ➤ Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the concerned course teacher as well as by an end semester examination and will be consolidated at the end of the course. Continuous Internal Assessment carries 30% weightage and Semester End University Exams carry 70% weightage.
- ➤ The components of Continuous Internal Evaluation of 30% weightage include:

  1) 20% for Internal Examination in each Semester and

  2) 10% for Attendance and class participation.

- ➤ The passing minimum for CIA (Continues Internal Assessment) shall be 36 % i.e., 11 marks out of 30 marks, where the candidate is required to appear for the internal test at least once in each semester.

- ➤ Failed candidates in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters by appearing for Re-test only once.

- ➤ The passing minimum for University or External Examinations shall be 36% i.e. 25 marks out of 70 marks. A student not securing minimum standard of 36% in each course in external examination shall be declared as unsuccessful or fail.

**GRADING SYSTEM:**

Once the marks of the CIA (Continues Internal Assessment) and end semester University Examination for each of the courses are available, they will be added. The marks thus obtained in each course will then be graded as per details provided in the table below:

**GRADING OF THE COURSES**

| Percentage / Marks | Grade Points | Grade | Description |
|---|---|---|---|
| Above 85 | 8.5 - 10.0 | O+ | Outstanding |
| 70 - 84..99 | 7.0 - 8.49 | O | Excellent |
| 60 - 69.99 | 6.0 - 6.99 | A | Very good |
| 55 - 59.99 | 5.5 - 5.99 | B+ | Good |

| 48 - 54.99 | 4.8 - 5.49 | B | Fair |
| 36 - 47.99 | 3.6 - 4.79 | C | Average |
| Below 36 | 0.0 | D ( Dropped) | Dropped or Fail |

**GRADES FOR FINAL RESULT:**

| CGPA From - to | Letter Grade | Classification of Final Result |
|---|---|---|
| 8.5 - 10 | O+ | First class with |
| 7.0 - 84.99 | O | Distinction |
| 6.0- 6.99 | A | First Class |
| 5.5 - 5.99 | B+ | Higher Second Class |
| 4.8 - 5.49 | B | Second Class |
| 3.6 - 4.79 | C | Pass Class |
| Below 3.6 - 0.0 | D | Dropped or Fail |

**EVALUATION & AWARD OF DIPLOMA**

1. In order to be declared successful in examination and declared as **PASS** the following conditions should be fulfilled:

(A) Minimum of 36% marks (C Grade) should be obtained by a student in each course both in internal evaluation as well as external evaluation done at the end of a semester.

(B) A student not securing minimum standard of 36% in external examination shall be declared as unsuccessful or fail. Anyone not securing 36% in internal evaluation in any course shall not be permitted to appear in semester end University examination in a concerned course.

(C) Unless all the conditions laid down above are fulfilled a student shall not be declared **PASS** and shall not qualify to obtain the P.G. Diploma Certificate.

2. A student is eligible to continue his/her studies for the second semester inspite of his failing in the First Semester end University examination.

3. The final Mark Sheet will include the credit points, marks obtained in each course in internal as well as external exams, the corresponding grades obtained in each course as well as overall Grade as per the Evaluation System described above.

# Question Paper Pattern
Unit wise questions as per format given by University.

# Practical

Unit wise questions as per format given by University.

# SYLLABUS

## POST GRADUATION DIPLOMA IN BIOINFORMATICS

**BIN-401: BIOINFORMATICS FUNDAMENTALS AND BIOLOGICAL DATABASES**

**(EXTERNAL 70+ INTERNAL 30=100 MARKS)**

### UNIT- 1:  :  Fundamentals of Computer

- **Computers:** Types of Computers, Input Process Output Cycle, Input / Output Devices Inside the CPU, (Motherboard, Processor, Ram, Rom) Storage Devices, S/W and Type of S/W.

- **Operating System:** Introduction to Windows, Files and Folders, Windows Explorer, MS Office, Linux/Unix

- **Basics of Networking:** LAN-MAN-WAN, Network Components, Internet, Web Browsers, E-Mails,
  WWW.

### UNIT- 2: Introduction to Bioinformatics

- **Bioinformatics:**An Introduction, Introduction about available Computational Tools and Databases on Bioinformatics sites, Biological Literature Information access, Storage and retrieval.

- **Bioinformatics Resources:** NCBI, EBI, ExPasy, Entrez & SRS System, Sequence analysis: Pairwise sequence alignment - NEEDLEMAN and Wunsch, Smith Waterman algorithms, Multiple sequence alignments - CLUSTAL and other different Bioinformatics Tools.

- **Database Similarity Searches**: BLAST, FASTA, PSI-BLAST algorithms

### UNIT- 3: Biological Databases

- **Primary Sequence & Structure Databases:** Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG.

- **Derived (Secondary) Databases of Sequences and Structure:** Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO, SSOP, CATH, DSSP, FSSP, RNAbase.

- **Genome Databases**: At NCBI, EBI, TIGR, SANGER, High-throughput genomics.

- **Sequences (EST, STS, GSS), ENSEMBL**

### UNIT- 4: Introduction to Biostatistics

- Measures of Central Tendency and Dispersion: Mean, Median, Mode, Variance, Standard Deviation, Quartile deviation.

- Sampling Distributions: Concepts, Sampling Distributions of Sample mean and proportions.

- Hypothesis: Z and t Distributions, F test. Chi Square Test: Goodness of fit, Independence of Attributes.

- Correlation and Regression: Introduction to Bivariate and Multivariate Regression using Computer softwares. Analysis of Variance: One way Classification using Computer software

- Probability: Basic concepts, Bayes's theorem. Probability Distribution: Binomial, Poisson, Normal Distributions with application in Biostatistics

**References-**

1. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
2. Bioinformatics Basics - By Hooman H. Rashidi, Lukas K. Buehler, CRC press
3. Introduction to Computers - Peter Norton, TMH6. The Internet: Christian Crumlish
4. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita Mendiratta, Parag Rastogi Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.

# BIN 402: Linux and System Development


**(EXTERNAL 70+ INTERNAL 30=100 MARKS)**

## UNIT- 1: Introduction to Linux O.S.

- **Introduction to O.S:** Types, Charateristics, Available Options**.**

- **Linux as O.S:** Benfits of Linux, Structure, Kernal, file System, available options.

- **Working with Linux Desktop**: Installation of Linux, Installing softwares, creating users, printing, etc.

UNIT- 2: Linux Commands and Filters

- **General Commands**: ls, clear, man, date, cal, echo, cat.

**File and Directory Commands**:  mv, rm, cp, pwd, mkdir, file comparision commands, cuting and pasting.

- **Advance Commands:**  head, tail, wc, bc, tee, uname, sudo, ispell, sort, merge, uniq, tr, granting previllages.

Unit –3:  Linux Shell Scripts and Advance Topics

- **Filters:** pipe, grep, sed, awk.

- **Shell Scripts:** shell, bash, essentials - command line arguments, using arguments in Shell scripts.

- **Controls Structures**: if-elif-else-fi, case-esac, for loop, while loop.

- **Network Utilities**: Network Configuration and Utilities, FTP clients, Terminal Servers Client.

- **Development Environment:** Introduction to various Development Tools – Eclipse.

- **Advancement in Linux:**  Advancements, Currrent Research and Developments in Linux, Applicaiton in research.

Unit –4: System Development Concepts, Analysis and Designing

- **Basic concepts of System development:** System development life cycle.

- **System analysis tools:** System designing tools.

***SUGGESTED READINGS:***

1. Operating Systems by Galvin, Addison Wessely
2. Modern Operating Systems by S. Tanenbaum, Prentice Hall (India)
3. Operating Systems Concept and Design by Milan Milenkovic,Tata McGraw Hill
4. Linux Pocket Guide Oreilly Media
5. Unix Concepts and Apllications by Sumitabha Das, Tata McGraw Hill
6. Modern Operating Systems – Andrew S. Tanenbaum, PHI Publications

 **Paper – 403: Practical 1** Based on paper PGD BIN 401


 **Paper – 404: Practical 2** Based on paper PGD BIN 402

# BIN 501: Genomics and Proteomics
### (EXTERNAL 70+ INTERNAL 30=100 MARKS)

UNIT- 1: Computational Genomics

- **Concepts of genomics:** Importance of genome comparison: Genome alignments, BLAST2, Mummer, Pipmaker, VISTA.

- **Comparison of Gene Order**

- **Genome database:** Understanding of and exploration of comparative Genomics database (SNP, dbSNP and SNP related databases).

- Genome databases and related resources (EST, STS, GSS).

UNIT- 2: Protein Structure and Computational Proteomics

- **Structure Analysis:** Prediction of secondary structure: STRIDE, PHD, PSI-PRED.

  **Tertiary structure prediction**: Homology modeling, Threading approaches, Ab-initio methods.

- **Anatomy of Proteins:** Ramachandran plot, Protein structure Motif, Domains, Folds, principles of protein folding.

- **Concept of proteomics:** Studies of protein related databases and DIP, PPI server, BIND, PIM.

- **Molecular interactions:** Protein–protein interaction, Protein–DNA interaction, DNA–Small molecule interaction, Protein – carbohydrate interaction.

UNIT- 3: Sequencing analysis tools and techniques

- **Sequencing:** Sanger sequencing principle and technique

- **Next Generation sequencing platforms:** Principles and techniques

- **NGS data analysis:** raw data file formats, assembly and annotations

UNIT- 4: Phylogeny

- **Phylogeny:** Distance methods (UPGMA, Neighbour joining, felestein), Distance models (Juke Cantor model, Kimura, Feleistein), Character methods (Max. Likelihood, Max parsimony).

- **Algorithms and Techniques:** Algorithm and sums of all the distance method to calculate the genetic distance, Tree evaluation techniques (Boot strap, Jack knife, Jumbling Sequence).

- **Application of phylogenesis**

- **Gene duplication, Horizontal Gene transfer**

### SUGGESTED READINGS:

1. The Phylogenetic Handbook: A Practical Approach to DNA and Protein Phylogeny -by Marco Salemi and Anne-Mieke
2. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
3. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita Mendiratta, Parag Rastogi
4. Introduction to Bioinformatics, Arthur M. Lesk

## BIN 502: Computational Drug Discovery and Pharmacogenomics
### (EXTERNAL 70+ INTERNAL 30=100 MARKS

UNIT- 1: Drug Discovery Concepts

- **Computer aided molecule modeling and drug discovery:** *In silico* drug designing.

- Identification of disease gene.

- Genetics of drug metabolism therapeutic targets.

- Interaction of molecules and gene based drug target.

UNIT- 2: Drug Design Techniques and Molecular Modeling

   **Analysis of protein sequences and epitope predictions:** Interactions of epitope with antibody, MHC molecule and TCR**.**

- Design of ligands for known macromolecules.

- **Ligand based computational approaches:** QSAR and Pharmacophore methods.

- **Molecular modeling and simulations:** Concept of molecular simulation, Simulation techniques, application with molecular docking.

UNIT- 3: Pharmacogenetics And Pharmacogenomics

- **Introduction:** Historical perspectives, current view of Pharmacogenetics, Pharmacogenetics.

- **Biomarkers:** Promise of personalized medicine. Genetic drug response profiles, effect of drug on gene expression.

- **Pharmacogenomics**: In drug discovery and drug development. Current status of pharmacogenetics, drug metabolism.

UNIT- 4: Advancements in Bioinformatics

- **Epigenetics and biological software:** Tools and databases.

- **Advance biological databases and tools:** DNA microarray**:** Understanding of microarray data, normalizing microarray data, detecting differential gene expression, co-relation of gene expression data to biological processes and computational analysis tools**.**

- Databases and basic tools, gene expression omnibus (GEO), Array express, SAGE database

### *SUGGESTED READINGS:*

1. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
2. Bioinformatics: From Genomes to Drugs, T. Lengauer, et al., Wiley-VCH, 2002
3. Burger's Medicinal Chemistry and Drug Discovery @ 6th ed.c Volume 1

4. Drug Discovery Handbook, S. Gad, John Wiley & Sons,2005
5. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita Mendiratta, Parag Rastogi

**Paper – 503: Practical 1** Based on paper PGD BIN 501


**Paper – 504: Practical 2** Based on paper PGD BIN 502