

**DEPARTMENT OF BOTANY, BIOINFORMTICS AND CLIMATE CHANGE
 IMPACTS MANAGEMENT, SCHOOL OF SCIENCE,
 GUJARAT UNIVERSITY, AHMEDABAD-380 009
 SYLLABUS: M. Phil. Bioinformatics**

Effective from June 2018

Semester		Course	No. of hours per week				Course credits
			Lectures	Others	Practical	Total	
1		Name					
	BIN 601	Research Methodology	3	1	--	4	4
	BIN 602	Biological Ethics and Computer	3	1	--	4	4
	BIN 603	Omics Technologies and Computational Drug Discovery	3	1	--	4	4
	BIN 604	Seminar, Field Work & Review Writing	3	1	--	4	4
2	BIN 605	Dissertation	--	—	8	8	8
		Total	12	4	8	24	24

Theory Papers

BIN 601: Research Methodology

70 Marks

Unit - 1 Laboratory Techniques

- Basic principles of safety in a laboratory, Health and safety: general safety, Chemicals-routine, reactive and toxic, care of handling and safety, burns in a lab and fire safety, Electric, UV and Radiation protection, Hazards- biological, Physical, chemical, precautions, disposal of chemicals and hazardous material.
- Basic laboratory procedures: distillation, drying, solvent extraction, preparing standard solutions, percent -ppm-molar solutions, buffer solutions and pH, Cleaning glassware, storing reagents, keeping stock of chemicals and glassware.
- Use and care of Laboratory instruments, equipment, microscopes, computers, printers etc.
- Making and recording measurements, SI units and their use, Scientific method-steps.

Unit - 2 Information Technology

- Information technology and library resources: The Internet and World Wide Web, internet resources for Botany using spreadsheets. Word processors, database and other packages.
- Finding and citing information, Online tools, Research ethics: Falsification and fabrication of data, Plagiarism, IPR,
- Biological Databases: NCBI, EMBL, DDBJ, Secondary databases.

Unit - 3 Research Design

- Research problem: meaning of research problems, sources of research problems. Criteria / characteristics of good research problem, errors in selecting a research problem ;
- Types of research: Qualitative -exploratory research and Quantitative - conclusive descriptive and casual research, Data collection-primary and secondary data, surveys and experimentation,
- Communicating information : General aspects of scientific writing, Reporting practical work, writing literature surveys and reviews, organizing a poster display, Research Report: Format of the research report, style of writing the report, references and bibliography, writing essays, Online tools meant for citation, correct usage of technical language and scientific peer network, and Presentations, print and online journals, ISSN, ISBN, H-index, impact factor, ResearchGate, Scopus, Google Scholar, etc
- Presentation skills: Effective oral scientific communication to specialized audiences, including peer groups, as well as general audiences such as students, the general population and policy makers.

Unit - 4 Statistics In Research Methodology

- Sample and population, measures of central tendency, measures of dispersion and variability. Standard deviation, Standard error, Quality assurance and quality control, errors - types of errors, Data analysis , Distributions, summary statistics,
- Hypothesis testing: One sample, two sample, paired sample and multiple sample hypothesis. Statistical analysis. Testing of hypothesis,
- Probability- definition, various events in probability, laws, Bayes' Theorem.

- Regression and correlation: Simple linear correlation and linear regression, multiple regression, significance of p, coefficient of determination and correlation coefficient. Use of t-test, chi-square test and F-statistics, Analysis of Variance -ANOVA, use of computer in statistical analysis, SPSS, confidence limits,

References

1. Research Methodology. Methods and Techniques C. R. Kothari and Gaurav Garg, New Age Publishers
2. Research methodology and Statistical analysis by O.R.Krishnaswamy and D.Obul Reddy, Himalaya Publishing House

BIN 602: Biological ethics and Computer

70 marks

Unit-1: Biological ethics and Philosophy

- Science: Morality and Ethics, Understanding and Challenges
- Biosafety- bioethics, concept, objectives, risk assessment
- DBT guidelines for approval of transgenics, Bioethics in biodiversity and resource management
- Good manufacturing practices (GMP), GLP, Government regulations, policies, Food and drug administration, Intellectual Property Rights

Unit-2: Biology in the computer Age

- Informatics means to Biologist, advances in Biology: Computational approach to Biological Questions
- Molecular biology's central dogma: Replication, Transcription, Translation
- Tools & Techniques in recombinant DNA technology: Cloning vectors.
- Polymerase chain reaction, DNA finger printing, DNA sequencing, Molecular markers
- Tools for Bioinformatics, futuristic Approaches

Unit - 3: Software and Bioinformatics Workstations

- Workstations, parallel processing computers, supercomputers, concept of cloud computing
- Software: Utility in Biological world, bacteria. Plants and Animal
- Operating systems and applications: Windows, Linux/Unix
- Linux and system development: Working with Directories and Files, Linux Commands and Filters, Shell Scripts and network utilities

Unit 4: Advance Databases Concepts and Applications

- Concept of data, data models, data representation, mining, various types of databases,
- Database management System (DBMS), Related programs: Oracle, SQL
- Data Mining: Data Mining on relational databases, Data Warehouses, Transactional databases
- Introduction to protein and nucleic acid databases, biological data and data analysis.
- Introduction to Big Data: Methods and Applications

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 Database Management Systems by Henry F. Korth
4. Managing Scientific Data, Zoe Lacroix, Morgan Kaufmann Publishers
5. Operating Systems by Galvin, Addison Wessely
6. Modern Operating Systems by S. Tanenbaum, Prentice Hall (India)

BIN 603: Omics technologies and Computational drug discovery

70 marks

Unit -1: Genomics

- Fundamentals of genomics: Genome information and special features, coding sequences, (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST)
- Importance of genome comparison, Genome alignments, Genome browsers
- Understanding of and exploration of comparative Genomics databases
- Next Generation sequencing technologies: methods and applications, NGS data analysis, transcriptomics, metabolomics and metagenomics

Unit -2: Proteomics

- Fundamentals of Proteomics: Structural and Functional aspects of proteins, Secondary structure, three-dimensional structure, protein folding and functional sites, protein folding classes
- Concept of proteomics: Studies of protein related databases
- Protein Structure Prediction methods: Homology modeling, prediction of protein structure from sequences, prediction of functional/active sites
- Predicting transmembrane helices, Primary structure analysis and prediction, Secondary structure analysis and prediction, motifs, profiles, patterns and fingerprints search.

Unit -3: Drug Discovery Concepts and Pharmacogenomics

- Steps in drug discovery process: Prodrugs and soft drugs, Drug targets , Drug solubility, Natural resources of lead compounds expression.
- Biological testing and bioassays, Preclinical testing and clinical trials
- Computer aided drug discovery: in silico drug designing strategies
- Genetics of drug metabolism therapeutic targets.
- Interaction of molecules and gene-based drug target.

Unit -4: Molecular Modeling and Simulations

- Molecular modeling:-Introduction, force field, quantum chemistry, Schrödinger equation, potential energy functions, energy minimization, local and global minima, grid search.
- Molecular mechanics:-Definition, force fields, bond-stretching, bond-bending, dihedral motions
- Concept of molecular docking and applications
- Concept of molecular simulation: force fields, MD methodology, periodic box, algorithm for time dependence

- Ligand based computational approaches: QSAR and Pharmacophore methods, 2D and 3D QSAR models, pharmacophore mapping

References

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

Paper-604: Seminar, teaching assignment, practical training, excursion, etc. **70 marks**

Dissertation: 160 marks (External) + 40 marks (Internal) **200 marks**