Comprehensive Examinations for the Program in Bioinformatics and Computational Biology

The Comprehensive exams will be given once a year. The format will be six exams. Students must show competency on all six parts and a high degree of competency on four of the six parts. Students will be allowed two attempts to successfully pass the exams.

Protein Structure Analysis

Complexity of protein structure and protein folding
Protein structure verification and validation
Secondary structure assignment and prediction
Protein structure classification

Comparative modeling and fold recognition
Protein structure prediction and structural genomics Protein engineering Protein structure databases Suggested primary sources reading at http://binfo.gmu.edu/vaisman/csi731/papers.html

Suggested text: Structural Bioinformatics (Philip Bourne and Helge Weissig, Eds), John Wiley &
Research Methods


Suggested Text: Fundamentals of Biostatistics Bernard Rosner

Biological Sequence Analysis

alignments. The HMMER system. Multiple sequence alignment: Scoring functions. Progressive alignment methods. CLUSTALW. Multiple alignment by profile HMM training. Phylogenetic analysis: Distance methods; Parsimony; Maximum likelihood. Gene-finding: Search by content; Search by signals.

Suggested Texts: *Biological Sequence Analysis* by Durbin, Eddy, Krogh and Mitchison (Chapters 1, 2, 3, 5, 6, 7, 8.1- 8.2). *Computational Molecular Biology* by Clote and Backhofen

**Numerical Methods for Bioinformatics**

Solution of Nonlinear Equations Solution of Simultaneous Linear Algebraic Equations Solution of Matrix Eigenvalue Problem Curve Fitting and Interpolation Random Number Generators Monte Carlo Methods Numerical Differentiation Numerical Integration Ordinary Differential Equations: Initial-Value Problems Ordinary Differential Equations: Boundary-Value Problems Partial Differential Equations Optimization Finite-
Element Method

Suggested Text:

*Applied Numerical Methods for Engineers and Scientists*

By Singiresu S. Rao

**Systems Biology**

enzyme-substrate kinetics (Michaelis Menten Kinetics, Law of Mass Action) protein synthesis DNA replication and transcription cellular respiration (glycolysis and oxidative metabolism).

cellular ionic homeostasis and excitable membranes (hodgkin huxley model, ion channels, pumps, exchangers). cellular signaling

(G-proteins, IP3, Calcium mobilization, ligand receptor dynamics)

Suggested text: *Molecular Cell Biology*, 4th ed; Harvey, Lodish et al.

*Molecular Biology of the Cell* by Bruce Alberts

Although there is no specific exam named,
students should be knowledgeable in the area of molecular, cellular and biochemistry of the cell since this information is essential for understanding the field of Bioinformatics and Computational Biology. Nucleic acid chemistry -biochemistry Molecular biology - history of the field - Central Dogma - recent revisions to CD - What is a gene? DNA replication -molecular biology -biochemistry - biotechnology -history of the field Genome sequence analysis - biotechnology -bioinformatics of sequence determination -history of the field -computational resources for analysis

Suggested Texts: *Molecular Cell Biology*, 4th ed; Harvey Lodish et al