Ph.D. Entrance Examination Syllabus (Bioinformatics) (2024-25)

Fundamentals of Molecular Biology

Biomolecules, structure and function of nucleic acids (DNA, RNA) and Amino acids (Proteins), transcription, translation and genetic code systems around the central dogma of molecular biology.

Database Management and Programming Concepts

Relational and E-R models, database system architecture, SQL, basics of data structures, data types, operators, lists, hashes and object-oriented programming concepts.

Biological databases

Importance of databases in bioinformatics, biological and bioinformatics databases-NCBI, PubMed, GenBank, EMBL, DDBJ, SwissProt-UniProt KB, PDB, KEGG, genomic databases, dbSNP, SRA, GEO.

Biological sequence analysis

Various file formats- FASTA, GenBank, EMBL, pair wise sequence alignment – methods and algorithms, Concepts of sequence similarity and homology, Scoring systems, Gap penalties and substitution matrices (PAM, BLOSUM), Dynamic programming algorithms: Needleman-Wunsch and Smith-Waterman algorithms, Heuristic methods: FASTA, BLAST, multiple sequence alignment – methods and applications., phylogenetics and molecular evolution.

Structural bioinformatics and Computer Aided Drug Design

Structural bioinformatics, Ramachandran plot, protein secondary and tertiary structure prediction methods, computer aided drug design: principles and applications, QSAR, Pharmacophore modeling, molecular docking, ADMET.

Advanced Topics and Future Trends in Bioinformatics

DNA sequencing methods and NGS technologies for biological sequences, Computational genomics, Systems and synthetic biology, Integration of bioinformatics with artificial intelligence and machine learning, Single-cell sequencing and its implications, Applications in precision medicine, healthcare and drug discovery.