

BI 408 MOLECULAR FORENSICS (ELECTIVE-VI)

Course Description and Objectives:

This course deals with the basic concepts of DNA forensics and various tools employed. The main objective of this course is to provide gain adequate knowledge in various types of PCR and techniques in DNA forensics.

Course Outcomes:

1. Students will be to choose the proper PCR method and technique for molecular forensic analysis
2. They will be able to demonstrate the process of paternity testing
3. They will be able to interpret DNA typing results
4. They will be familiarized with various legal perspectives of permissibility of DNA testing
5. They will be able to use various population databases of DNA markers.

Unit I: Introduction to Bioinformatics :

Bioinformatics: Introduction, Theory and practice of database searching, Integrated information retrieval, Internet access, Searching for sequence homology and alignment. Basic concepts of UNIX database and programming, Computing concepts of the UNIX operating system. Patent laws and Intellectual rights.

Unit II: Introduction to DNA forensics and types of PCR :

Introduction to DNA forensics, Scope and application of DNA forensics in animal and human criminal investigations in variety of situations. Types of PCR: Nested PCR, Touchdown PCR, Gradient, PCR, Hot-starts PCR, Quantitative PCR, multiplex PCR. DNA quantification by Slot- blot assay, Pico-green micro-titer plate assay, AluQuant human DNA quantification system, endpoint PCR, PCR inhibitors & solutions, Contamination Issues, etc.

UNIT III: Techniques in DNA forensics :

Uni-parentally inherited genetic markers in ethnic and geographical origin detection, DNA Profiling Kits (Easy DNA, Pro-filer, etc.) DNA fingerprinting of degraded samples, Slot-blot assay for quantification of DNA, DNA-DNA Hybridization, SNP microarray for supplementary paternity testing. Genetic analysis of chromosome X (pentaplex/heptaplex PCR assay), multicopy Y-STR analysis, mitochondrial DNA analysis, DNA multi-reverse parental analysis, cytochrome b analysis, eDNA Personal Effects and DNA analysis(sources and problems)

UNIT IV: Forensic DNA evidence interpretation :

Advantages, disadvantages and limitations of DNA forensics. Interpretation of DNA typing results: Complicating Factors (Multiple contributors, degradation, and extraneous substances), System-specific Interpretational Issues (RFLP, PCR systems). Assessing strength of evidence: Determination of Genetic Concordance, Evaluation of Results, Frequency Estimate Calculations, Population Substructure, Likelihood Ratios, and Uniqueness of DNA Profile.

UNIT V: DNA Fingerprinting Applications :

Case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases ;Legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers –STRs, Mini STRs, SNPs. Uses of STR Typing, New & future technologies: Microarrays technology, Synthetic DNA, analysis of Degraded DNA, Low Copy Number DNA, MALDI-ToF, Mass Spectrometry.

Text Books :

1. Molecular Forensics - by Ralph Rapley (Editor), 2004, David Whitehouse (Editor)
2. Principles and Techniques of Biochemistry and Molecular Biology - Keith Wilson and John Walker, 2010

References Book :

1. PCR (Basics: from Background to Bench) - M. J. McPherson and S. G. Moller.