

Introduction of the Course

This course involves the Study of Structural and Functional role of Macromolecules in Eukaryotic Genomic System. Genomics is the study of genomes which refers to the complete set of genetic material present in a cell or organism. Thus, genomics is the study of the genetic make-up of organisms while proteomics is the branch of molecular biology that involves the study of the structure and function of the proteins, their mutual interactions and coordinated expression in a living system. Thus, the current course will help the students to have conceptual knowledge about genes and proteins.

Course Objectives

1. To enable the students to understand the structural and functional basis of genes and proteins and their mutual interactions
2. To make the students familiar with the most advanced techniques in the fields of genomics and proteomics

Contents**Unit I: Genomics**

- Genome sequencing strategies and programs, new technologies for high-throughput sequencing, methods for sequence alignment and gene annotation
- Approaches to analyze differential expression of genes – ESTs, SAGE, microarrays and their applications; gene tagging; gene and promoter trapping; knockout and knockdown and knock-down mutants; dynamic modulation of protein structure and function; Comparative genomics of model plants and related crop special Recombination-based cloning techniques
- RNAi and gene silencing; genome imprinting, small RNAs and their biogenesis, role of small RNAs in heterochromatin formation and gene silencing
- Genomic tools to study methylome and histone modifications.

Unit II: Proteomics

- Analysis of proteins by different biochemical and biophysical procedures like CD (Circular Dichroism), NMR, UV/Visible and fluorescent spectroscopy
- Protein identification and analysis, other protein related databases, 1-D and 2-D gel electrophoresis for proteome analysis, Sample preparation, gel resolution and staining; Mass spectrometry based method for protein identification like PMF (protein mass fingerprinting) and LCMS; image analysis of 2D gels: Data acquisition, spot detection & quantitation, gel matching, data analysis, presentation, databases, conclusions; DIGE (Differential In Gel Electrophoresis), alternatives to 2-DE for protein expression analysis
- Analysis of post-translational modifications and protein-protein interactions; protein chips and arrays, future directions in proteomics, scope of functional proteomics.

Practicals:

1. DNA amplification through PCR
2. Real-time PCR
3. Northern and Western Blotting
4. 2D electrophoresis
5. Differential staining procedures

Teaching-learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

Assessment and Examinations:

As per University Rules

Recommended Readings

1. Bernot, A. (2005). *Genome Transcriptome and Proteome Analysis*. John Wiley and Sons, Inc. New York.
2. Buchanan B, Gruissem G, and Jones R (2015) *Biochemistry and Molecular Biology of Plants*, American Society of Plant Physiologists, USA.
3. Cecconi, D. (2021). *Proteomics Data Analysis*. Springer (1st Ed.).
4. Colin, A. (2001). *DNA Sequencing Protocols*. Publishers John McGraw Hill.
5. Dziuda, D. M. (2010). *Data mining for Genomics and Proteomics: Analysis of Gene and Protein Expression Data* (Vol. 1). John Wiley & Sons.
6. Hammes, G.D. (2005) *Spectroscopy for the Biological Sciences*; Willey Inter science, USA.
7. Harlow and Lane, D. (Eds.) (1998) *Antibodies _ A Laboratory Manual*; Cold Spring Harbor Laboratory, USA.
8. Kahl, G. (2015). *The dictionary of genomics, Transcriptomics and Proteomics, 4 Volume set*. John Wiley & Sons.
9. Lesk, A. M. (2017). *Introduction to Genomics*. Oxford University Press.
10. Lieber, D.C. (2002) *Introduction to Proteomics: Tools for New Biology*; Humana Press, NJ.
11. Pennington SR, Dunn MJ (Eds.) (2002) *Proteomics: From Protein Sequence to Function*, BIOS Scientific Publishers, United Kingdom.
12. Pevsner, J. (2015). *Bioinformatics and Functional Genomics*. John Wiley & Sons.
13. Sambrook J and Russell DW (2001) *Molecular Cloning – A Laboratory Manual*, Vols I –III, Cold Spring Harbor Laboratory, USA.
14. Sensen, C.W. (2005). *Hand Book of Genome Research: Genomics, Proteomics, Metabolomics, Bioinformatics, Ethics and Legal Issues*. John Wiley and Sons, Inc. New York.
15. Singer M and Berg P (1991). *Genes and Genomes: A Changing Perspective*; University Science Books, CA, USA.
16. Thompson, J.D. (2010). *Functional Proteomics – Methods and Protocols*. (2nd ed.) Schacffli. Rciss, Christine; Ueffing, Marius Press. Springer.
17. Wink, M. (Ed.). (2013). *An introduction to molecular biotechnology: fundamentals, methods and applications*. John Wiley & Sons.
