INTRODUCTION TO PROTEOMICS

PROF. SANJEEVA SRIVASTAVA
Department of Biosciences & Bioengineering
IIT Bombay

INTENDED AUDIENCE : It would be applied to B.Sc., M.Sc. and MS.
PRE-REQUISITES : Any B.Sc. or M.Sc.The target audiences of this course are required to have a basic introduction to biology.

COURSE OUTLINE :

This course introduces to the basic biology of proteins and the new advanced science called as proteomics which aims to look into the protein properties from a global perspective, i.e., not undertaking one protein at a time, but an entire set of proteins in the milieu. The course will cover in detail the two major aspects of proteomics i.e., Gel-based proteomics and Mass spectrometry-based proteomics. The gel-based module will cover different techniques like SDS-PAGE, 2-DE, 2D-DIGE etc. These techniques had a major contribution in transition from protein chemistry to proteomics. Mass spectrometry, on the other hand, is an advanced analytical technique for accurate mass measurement. In this module, we will discuss the basics of mass spectrometry, sample preparations, liquid chromatography, hybrid mass spectrometers and quantitative proteomics techniques such as iTRAQ, SILAC and TMT using mass spectrometry. The course will also provide the basic knowledge about sample preparation, mass spectrometry workflow, different chromatography technologies and quantitative proteomics.

ABOUT INSTRUCTOR :

Prof. Sanjeeva Srivastava Dr. Sanjeeva Srivastava is a Professor and group head of proteomics laboratory at the Indian Institute of Technology, Bombay. He obtained his Ph.D. from the University of Alberta and post-doc from the Harvard Medical School in the area of proteomics, stress physiology and has specialized expertise in applications of data enabled sciences in global health, developing country and resource limited settings. He joined IIT Bombay in 2009 as an Assistant Professor and currently working as Professor. Current research in his group centers on biomarker and drug target discovery and deciphering the protein interaction networks in complex human diseases (gliomas) and infectious diseases (malaria) using high throughput proteomics, protein microarrays and mass spectrometry. Dr. Srivastava is an active contributor to global proteomics science and innovation. He serves on the Executive Council of Human Proteome Organization (HUPO) and Proteomics Society, India (PSI). He has organized three successful international conferences & workshops at IIT Bombay PSI-2014, Targeted Proteomics International Symposium in 2015 and 2018. He has published four special issues as editor, Proteomics in India for Journal of Proteomics; Proteomics Research in India for Nature India, Protein Arrays for Proteomics and Neglected Tropical Infectious Diseases for Proteomics Clinical Applications. Having an extensive teaching experience at IITB and experience of conducting proteomics courses at CSHL, New York provided him with the background to increase proteomics education for the global community. One of his special contributions has been the development of e-learning resources (MOOC mass spectrometry and interactomics courses; Virtual Proteomics Laboratory). He has made first ever proteomics documentaries Proteomics: Translating the Code of Life and Human Proteome Project (HPP). He has directed HUPO Perspective in Proteomics video interview series, which is hosted on HUPO website. Recently we have signed a MOU on clinical proteogenomics cancer research with National Cancer Institute, along with Tata Memorial Centre and India has now become 12th country to join the International Cancer Proteogenome Consortium (ICPC). Dr. Srivastava continues to develop proteomics & omics science and innovation together with and for the next generation of keen students, researchers and the research and education commons in Asia and global OMICS community. Click here to view Faculty Profile: http://www.bio.iitb.ac.in/~sanjeeva/ About the Instructor: https://youtu.be/sb4faypvWwk

COURSE PLAN :

Week 1 : Basics of Proteins and Proteomics

Lecture 1 : Introduction to amino acids
Lecture 2 : Introduction to Proteins
Lecture 3 : Protein folding & misfolding
Lecture 4 : Introduction to Proteomics
Lecture 5 : Lab session – Protein-protein interaction using label-free biosensors

Week 2 : Gel-based proteomics

Lecture 6: Sample preparation and pre-analytical factors
Lecture 7 : Sample preparation: Pre-analytical factors (contd.)
Lecture 8 : Sample preparation: Protein extraction and quantification
Lecture 9 : One-dimensional electrophoresis
Lecture 10 : Introduction to 2-DE

Week 3 : Two-dimensional gel electrophoresis (2-DE)

Lecture 11 : 2-DE: Second dimension, staining & destaining
Lecture 12 : 2-DE: Gel analysis
Lecture 13 : 2-DE Applications
Lecture 14 : 2-DE Applications (contd.) & Challenges
Lecture 15 : Lab session - Protein/peptide pre-fractionation using OFFGEL FRACTIONATOR & data analysis

Week 4 : Difference in gel electrophoresis (DIGE) & Systems Biology

Lecture 16 : 2D-DIGE: Basics
Lecture 17 : 2D-DIGE: Data analysis
Lecture 18 : 2D-DIGE: Applications
Lecture 19 : Systems biology and proteomics – I
Lecture 20 : Systems biology and proteomics - II

Week 5 : Basics of mass spectrometry

Lecture 21 : Fundamentals of mass spectrometry
Lecture 22 : Chromatography technologies
Lecture 23 : Liquid chromatography
Lecture 24 : Mass spectrometry: Ionization sources
Lecture 25 : Mass spectrometry: Mass analyzers

Week 6 : Basics of mass spectrometry and sample preparation

Lecture 26 : MALDI sample preparation and analysis
Lecture 27 : Hybrid mass spectrometry configurations
Lecture 28 : Lab session - Demonstration of Q-TOF MS technology
Lecture 29 : In-gel & in-solution digestion
Lecture 30 : Lab session - Sample preparation: tissue sample preservation technology

Week 7 : Quantitative proteomics

Lecture 31 : Introduction to quantitative proteomics
Lecture 32 : SILAC: In vivo labelling
Lecture 33 : iTRAQ: In vitro labelling
Lecture 34 : TMT: In vitro labelling
Lecture 35 : Quantitative proteomics data analysis

Week 8 : Advancement in Proteomics

Lecture 36 : Proteomics applications
Lecture 37 : Challenges in proteomics
Lecture 38 : OMICS and translational research
Lecture 39 : Lab session – Targeted proteomics using triple quadrupole mass spectrometry
Lecture 40 : Lab session – Targeted proteomics: multiple reaction monitoring