COURSE DESCRIPTION

Course Name: Introduction to Proteomics
Course Number: BY 517
Credit: 3-0-0-3
Prerequisites: - IC 136 - Understanding Biotechnology & its Applications

Students intended for: B. Tech. 3rd and 4th year, MS/MSc. /M.Tech., Ph.D.
Elective or Core: Elective
Semester: Even

Comments: The course content for BY 517 has been revised. The revised content as recommended by 33rd BOA held on 31st January, 2020 and approved by 24th Senate meeting held on 13th February, 2020 is as mentioned below.

Course objective: This course will introduce the concepts of Proteomics – its principles and techniques which play a significant role in modern systems biology and related areas. Proteomics deals with the qualitative and quantitative analysis of the entire protein complement of any cell/tissue/organ/species/biological system expressed in a specific time and space. This course introduces the basics of evolution of proteomics as an area, the experimental aspects of tools and techniques in addressing systems level applications. As a result of this course, the students will have strong foundations and first hand scientific understanding of current state-of-the-art trends in Mass Spectrometry based Proteomics and its applications.

Course Outline:

Module 1 (6 hours): An introduction to proteomics: Basics of protein structure and function, An overview of systems biology, Evolution from protein chemistry to proteomics

Module 2 (6 hours): Abundance-based proteomics: Sample preparation and prefractionation steps, Gel-based proteomics - two-dimensional gel electrophoresis (2-DE), Two-dimensional fluorescence difference in-gel electrophoresis (DIGE), Principles of Blue Native-PAGE, Staining techniques, Fundamentals of liquid-chromatography (LC) based protein and peptide separation methods.

Module 3 (6 hours): Central role of mass spectrometry: Different types of mass spectrometers with respect to source ionization and design, Different kinds of mass analyzers, Different mode of data acquisition; Concepts of top-down vs bottom-up approaches and targeted vs untargeted approaches in proteomics.

Module 4 (6 hours): Quantitative proteomics - stable isotope labeling by amino acids in cell culture (SILAC), Isotope-coded affinity tag (ICAT), Isobaric tagging based methods for quantitative proteome analyses (iTRAQ/TMT), Label free quantitation (LFQ) (MS based, data-independent acquisition-DIA etc.), Targeted approaches (SRM,MRM). Challenges in performing proteomics in biofluids such as plasma, serum etc. (clinical proteomics).

Module 5 (6 hours): Functional proteomics: Recombinational cloning, Protein-protein interaction techniques by yeast two-hybrid, immunoprecipitation, protein microarrays, Nucleic Acid Programmable Protein Array (NAPPA), Surface Plasmon Resonance (SPR); Understanding post-translational modifications (PTMs) mainly phosphorylation and glycosylation.

Module 6 (6 hours): Structural proteomics; Protein cross-link detection methods using mass spectrometry.

Module 7 (6 hours): Bioinformatics in proteomics; Manual interpretation of typical mass spectra, Mass spectrometry big data analyses using open-source software suits; Challenges and future prospects of proteomics research.

Text book

Introducing Proteomics: From Concepts to Sample Separation, Mass Spectrometry and Data Analysis, J. Lovric, John-Wiley & Sons, Hoboken, New Jersey, USA; 2011. ISBN: 978-0-470-03524-5, ISBN: 978-1-119-95719-5 (eBook).

Lehninger Principles of Biochemistry (Seventh Edition), David L. Nelson, Michael M. Cox. Macmillan learning, 2017, ISBN:9781464187957 (eBook)

Other reference books

Introduction to Proteomics: Tools for the New Biology, D.C. Liebler, Humana Press, 2002. ISBN 978-1-59259-130-5

Proteomics for Biological Discovery, T.D. Veenstra, J.R. Yates III, John-Wiley & Sons, Hoboken, New Jersey, USA; 2006. ISBN 978-0-471-16005-2

Proteomics: A Cold Spring Harbor Laboratory Course Manual, A.J. Link and J. LaBaer, Cold Spring Harbor Laboratory Press, 2009 ISBN 978-087969787-7

Introduction to Proteomics: Principles and Applications, N.C. Mishra, John-Wiley & Sons, Hoboken, New Jersey, USA; 2010. ISBN:9780471754022 (print), ISBN:9780470603871, DOI:10.1002/9780470603871.

Mass Spectrometry Data Analysis in Proteomics, R. Matthiesen, Humana Press, 2020. ISBN 978-1-4939-9743-5, ISBN 978-1-4939-9744-2 (eBook), DOI:10.1007/978-1-4939-9744-2.

Recent research articles will be advised accordingly.