BITS PILANI, DUBAI CAMPUS

ACADEMIC – UNDERGRADUATE STUDIES DIVISION

First Semester 2023 – 2024

Course Handout (Part – II)

Date: 28.08.23

In addition to Part I (General Handout for all courses appended to the Time Table) this portion further specific details regarding the course.

Course No. : BIOT F345 **(3 0 3)**
Course Title : Proteomics
Instructor-in-charge : **Dr. S. Ramachandran**
Course Instructors : Dr. S. Ramachandran

Scope and Objective of the Course:
This course is designed to impart knowledge of proteomics which is one of the fundamental requirements for the biotechnology. It is organized to make the student understand various tools used in structural and functional proteomics and to analyze current and newly emerging mass spectrometry based technologies and approaches in protein and proteome analysis with regard to their applications in biology, biotechnology, medicine and systems biology.

Course Pre/Co- requisite (if any) **& Catalogue / Bulletin Description:** *Given in the Bulletin 2023 – 2024*

Text book [TB]
T1: Proteomics for Biological Discovery, Timothy D. Veenstra, John R. Yates, Publishers: John Wiley & Sons Ltd. Edition: 1st edition 2006

Reference book(s) [RB]:
R1: Proteins and Proteomics: A Laboratory Manual, Richard J. Simpson, Cold Spring Harbor Laboratory.
R2: Proteomics: From Protein Sequence to Function, S. R. Pennington, M. J. Dunn, Springer-Verlag, 1st edition, 2001
R3: Mass Spectrometry in Chemical Biology: Evolving Applications, Norberto Peporine Lopes, Ricardo Roberto da Silva, 1st edition, Royal Society of Chemistry, 2017
R4: Principles of Proteomics, Richard Twyman, 2nd edition, Taylor & Francis, 2008

Course Plan / Schedule:

Lec. No	Topics to be covered	Learning objectives	Ref. to Text Book
1-2	Proteomics and Experimental Biology	Introduction and overview of proteomics	Class notes
3-6	Protein separation methods	Protein fractionation, chromatography and electrophoresis techniques, isoelectric-focusing, two dimensional-SDS-PAGE, protein visualization, image analysis	T1: 2,6 R1: 4
7-10	Principles of Mass Spectrometry	Understand the principles of mass spectrometers used for proteome analysis, Mass spectrometry, ionization methods, types of mass analyzers	T1: 1, class notes R1: 8
11-13	Determining protein sequence	Edman degradation, mass fingerprinting and de novo sequencing using b and y ion series	Class notes
14-17	Quantitative proteomics	Isotope labeling, in vitro and in situ labeling techniques, incorporation of labeled amino acids	T1: 3, class notes
18-20	Post translational modifications	Phosphorylation, Acetylation, Hydroxylation, Methylation Glycosylation, AMPylation, Lipidation, Ubiquitination, SUMOylation, Deamidation etc	Class notes
21-23	Systematic analysis of protein modifications by mass spectrometry	Understand the principles and limitations of mass spectrometric methods for the analysis of PTMs	T1: 4, class notes
24-25	Workflows in mass spectrometry based proteome analysis. Large scale proteomic tandem mass spectrometry	Understand the principles of the main work-flows used in mass spectrometry, gel based techniques, MudPIT, mass spectrometry derived proteomic data of whole cell lysates, subcellular organelles including ribosomes, mitochondria, nucleus, understand the principles and computational resources	T1: 5 Class notes
26-27	Protein Microarrays and microfluidics-	Protein microarray and microfluidics, development, fabrication, detection systems and data analysis	T1: 10, 11

	based proteome analysis		
28-29	Clinical Proteomics	Application of proteomics in diagnosis and biomarker discovery, biomarkers, medical statistics to assess diagnostic performance of biomarkers, disease diagnosis	T1: 13
30-32	Functional proteomics	Fluorescent proteins for protein localization, applications in biological pathways, cell imaging, fluorescence resonance energy transfer (FRET) and its applications	T1: 7
33-35	Characterization of protein complexes	Protein complexes, RNases, RNA polymerase, ribosomes assembly	T1: 8 R1: 10
36-38	Structural Proteomics	Nuclear magnetic resonance (NMR), and X-ray crystallography	T1: 9
39-41	Informational resources for mass spectrometry-based proteomics	Understand the computational resources for mass spectrometry-based proteomics, and their use that are publicly accessible and commercial software used to identify peptide sequences from fragment ion spectra, validate results from sequence database searches	T1: 15

Course Learning Outcomes (CLOs)

Upon successful completion of this course, students should be able to:

- **CLO1** Understand the importance of proteomics in systems biology and medical biotechnology
- **CLO2** Understand the concepts and workflows involved in protein identification, and predict peptide sequence from MS/MS data for de novo sequencing
- **CLO3** Analyze the molecular, cellular, and biological processes using proteomics techniques
- **CLO4** Apply the use of proteomics in diagnosis, biomarker discovery and to study the structure and functions of proteins
- **CLO5** Apply the use of computational resources, biological databases, and tools used in proteomics

Evaluation scheme:

EC No	Evaluation Components	Nature of Component	Duration	Weightage %	Date & Time	Venue
1	Quiz-1	Closed book	20 mins	10	To be held periodically	TBA
2	Midsem	Closed book	90 mins	30	03.11.2023 FN	
3	Quiz-2	Closed book	20 mins	10	To be held periodically	
4	Take Home Assignments (OB)	NA	-	10	TBA	
5	Comprehensive Examination	Closed/Open Book	3 hours	40	09.01.2024 FN	

Mapping of CLOs, PLOs, and CECs

CLOs	PLOs	Evaluation Components (ECs)				
		EC1	EC2	EC3	EC4	EC5
CLO1	2,5	✓	✓		✓	✓
CLO2	3,4,5	✓	✓		✓	✓
CLO3	3,4		✓	✓	✓	✓
CLO4	3,4,5			✓	✓	✓
CLO5	3,4,5				✓	✓

* Please refer the link for the PLOs of the B.E. Biotechnology program.

#**Assignment / Practical / Field / Case Studies:** The Assignment / Practical will be given / conducted on either some or all of the above mentioned topics. Case studies, interpretation of data and then analysis, will form a part of all evaluation components. Assignments(s) may include seminar presentation and viva. Details will be intimated through a separate notification or announced in the class and the deadlines would be indicated therein. However, all assignments/reports would be completed by last week of December, 2023. It is necessary that all students stick to time schedule and do not postpone submission of

assignments/reports. This will prevent extra load during last two weeks of class work. No make-ups would be allowed for submission of assignments / practical reports.

Reading Assignments: Students are advised to read, collect additional information on the above mentioned topics as per given schedule. In addition, awareness w.r.t. latest developments in the area would be an added advantage

Mid-Sem Grading:
Mid-sem grading will be displayed after two evaluation components. (Refer Academic calendar for schedule).
Note: A student will be likely to get "NC", if he / she doesn't appear / appear for the sake of appearing for the evaluation components / scoring zero in pre-compre total.

Makeup and Attendance policies:
Make-ups: are not given as a routine. It is solely dependent upon the genuineness of the circumstances under which a student fails to appear in a scheduled evaluation component. In such circumstances, prior permission should be obtained from the Instructor-in-Charge (I/C). Students with less than 60% of attendance will not be allowed to avail the make-ups. The decision of the I/C in the above matter will be final.

Attendance: Every student is expected to be responsible for regularity of his/her attendance in class rooms and laboratories, to appear in scheduled tests and examinations and fulfill all other tasks assigned to him/her in every course. A student should have a minimum of 60% of attendance in a course to be eligible to appear for the Comprehensive Examination in that course. For the students under the purview of Academic Counseling Board (ACB), the Board shall prescribe the minimum attendance requirement on a case-to-case basis. Attendance in the course will be a deciding factor in judging the seriousness of a student which may be directly / indirectly related to grading.

General timings for consultation: W4 will be the chamber consultation hour, however students can meet the concerned instructor by prior appointment mutually convenient for both.

General instructions: Students should come prepared for classes and carry the prescribed text book(s) or material(s) as advised by the Course Faculty to the class.

Notices: All notices concerning the course will be displayed on the respective Notice Boards or Google classroom.

Instructor-in-Charge
BIOT F345

Contact Details:
Dr. S. Ramachandran, Professor, Chamber No:322, Contact No: +971 42753700 Ext: 421 Mobile No: +971-582706578 email: sramachandran@dubai.bits-pilani.ac.in