SEMESTER S7

PROTEOMICS & PROTEIN ENGINEERING

Course Code	**PEBBT756**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Foundation in Molecular Biology and Cell Biology	**Course Type**	Theory

Course Objectives:

This course introduces the student to the molecular and cellular principles behind how a single cell becomes a multicellular organism with specialized tissues and organs. The students will learn

1. To ask the key questions in development
2. How cells communicate in promoting the development of a multicellular organism
3. How the body plan of a multicellular organism is patterned to give rise to specialized tissues and organs
4. To appreciate the conservation of the molecular and cellular principles across different species
5. To understand the influence of the external environment in the developmental process, and
6. To analyse and integrate the scientific data that are used to answer all these questions in development.

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Overview of protein chemistry** Proteomics and its application, Functional proteomics in post genomic era, Proteomics experimental workflows, Gene-Protein families link with examples, Human proteome draft **Application of Chromatography in proteomics** Application of separation techniques in proteomics - Multidimensional chromatography, use of nanoLC, COFRADIC combined fractional diagonal chromatography, HILIC-hydrophilic interaction liquid chromatography,	**9**

	SAX- strong anion exchange chromatography, SCX- strong cation-exchange chromatography, affinity chromatography, reverse phase	
2	**Abundance based Proteomics** Gel based proteomics. Variations in 2-D gel electrophoresis, Difference Gel Electrophoresis (DIGE), and Mass spectrometry based proteomics- Analysis of data, MALDI, SELDI, Peptide mass fingerprinting, Protein microarray (analytical, functional, reverse phase), protein sequencing **Structural Proteomics** Application of X-ray crystallography, Circular Dichroism, Nuclear Magnetic Resonance, Plasmon Resonance, Small Angle X-ray Scattering	**9**
3	**Post-translational modification and Tagging of Proteins** Analysis of posttranslational modifications, Phosphorylation, ubiquitination (poly and mono), acetylation, nitration, glycosylation, Sumoylation, disulphide bond formation, signal peptide cleavages. Tagging of proteins with chemical and genetic approaches **Targetted Proteomics – Macromolecular Interactions** Qualitative and quantitative proteome analysis, Short-gun proteomics for proteome profile (whole proteome and sub-proteome analysis), Expression proteome analysis (isotope-labeling and label-free approaches), Proteomic analysis of protein-protein (including antigen-antibody interactions for epitope mapping), protein-DNA interactions, Identification of ligand receptor pairing and transcriptional regulators.	**9**
4	**Proteomics in Clinical and Drug Discovery Applications** Proteomics in study of diseases, Storage transportation and processing of clinical samples, Proteomic analysis of body fluids, Western Blotting, systems biology approaches and interaction network for drug discovery **Protein Engineering** Proteins design and engineering, Random, site directed mutagenesis; Strategies to alter catalytic efficiency; structure prediction and modeling proteins; Molecular graphics in protein engineering; Dynamics and mechanics; Drug-protein interactions and Design; applications of engineered proteins.	**9**

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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

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Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the knowledge of protein structure and function understanding in designing strategies for proteomic analysis and protein engineering.	**K3**
CO2	Analyse proteomic data using databases	**K4**
CO3	Solve problem related to protein function and efficiency with tools and techniques for protein engineering and	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	1	1	1	-	-	-	-	-	2
CO3	2	3	2	1	1	1	1	-	-	-	-	2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Proteomics	R.M. Twyman	Bioscientific Publishers	2013
2	Biotechnology	David Clark and Nanette Pazdernik.	2nd Edition, Academic Cell.	2015
3	Molecular Biology of the Cell	B. Alberts,D.Bray, J.Lewis et al,	Garland Pub. N.Y	1983
4	Proteomics in Practice: A Guide to Successful Experimental Design	Westermeier R Naven T	Wiley-VCH	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Proteomics: Methods and Protocols (2017), Methods in Molecular Biology Series	Humana Press. USA.	Ed. Lucio Comai · Jonathan E. Katz Parag Mallick	2017
2	2006) Protein Biochemistry and Proteomics (The Experimenter Series)	Hubert R	Academic Press	2006
3	(2009) Proteomics: A Cold Spring Harbor Laboratory Course Manual	Link AJ, LaBaer J	Cold Spring Harbor Laboratory Press	2009

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc20_bt20/preview
2	https://onlinecourses.nptel.ac.in/noc24_bt40/preview
3	https://archive.nptel.ac.in/courses/102/101/102101055/
4	https://archive.nptel.ac.in/courses/102/103/102103017/

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