Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2020-2021

Course Handout

Date: 12-08-2020

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : BIO G651
Course Title : Protein and Enzyme Bioengineering
Instructor-in-Charge : Ramakrishna Vadrevu
Lab Instructor: I. Shivakumar Sharma& Monica Singh

Course Description: sources, isolation, purification and storage of protein and/or enzymes; kinetics of enzyme catalyzed reactions; biocatalyst reaction engineering; techniques of production and recovery of enzymes; protein and enzyme modification; clinical and industrial applications of free and immobilized enzymes

Scope and Objective of the Course: The course will provide fundamental insights into the aspects of protein engineering principles, techniques and recent advances in manipulating proteins and enzymes, and their clinical and biotechnology applications. Enzyme production, kinetics and immobilization methods will be emphasized together with case studies to reinforce the impact of protein and enzyme engineering in basic biological research and biotechnology applications. The main objective of the course is to understand the principles and procedures to altering proteins and enzymes for applications in diverse areas.

Textbooks:

1. Enzyme Technology, Noorlabettu Krishna Prasad, PHI Learning Private Ltd. New Delhi, 2011. (Text book is available for purchase on line)

Reference books

1. **R1**. Sheldon Park and Jennifer Cochran. Protein Engineering and Design. CRC Press, 2010
2. **R2**. Carl Branden & John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing Inc.
3. **R3**. Methods in Molecular Biology Volume 244: Protein Purification Protocols (IInd Ed) Ed. Paul Cutler, Humana Press

In addition to the text and reference books, necessary and relevant material is indicated as Review(s) and will be provided.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1	Aspects of protein engineering and design: Perspective	Aspects of Protein engineering	Class Notes

2-9	Protein Structure Hierarchy, Classes, Protein folds and concept of active site structures in some protein folds. Protein structure, stability and folding, CD/FL spectrophotometric methods for structure and stability analysis	Protein structure /function & Protein Folding and stability review	R2 (2-6), Class Notes/Review(s)/ articles from literature
10-14	Protein/enzymes production& purification	Sources Isolation Purification methods (chromatographic) Ion-exchange, Affinity; Size exclusion, Hydrophobic, FPLC Storage of proteins	R3 (2-4; 12-16; 26-27) Class Notes
15-23	Overview of methods in Protein Engineering	Phage Display Systems Cell Surface Display Systems Cell Free Display Systems Library construction Computational methods	R1 (1-4) Class Notes Literature Articles
24-31	Rational Methods De novo design Directed Evolution Knowledge-Based Protein Design	Strategies of Protein/Enzyme Engineering	R1 (4,11) Class Notes Reviews/research articles
31-34	Properties of Enzymes Protein modifications (Mass spectrometry, Basic theory and applications in detection of proteins and protein modifications) ,	Enzyme and Protein Modifications	T1 (1); Class Notes/Literature articles/reviews
35-37	Free energy of activation Factors affecting Enzyme kinetics Michaelis-Menten Theory of Enzyme kinetics; Linear equations; Enzyme inhibition	Enzyme Kinetics	T1 (2) Class notes
38-41	Immobilization techniques, experimental procedures, properties of immobilized enzymes, enzyme stabilization	Enzyme Immobilization	T1 (6), Class notes, Literature articles
42-43	Clinical and industrial applications, specific examples	Applications of free and immobilized enzymes	T1 (7), self-study from recent literature

Practical No.	**Experiment Title**
1-3	Exploring primary and secondary databases on protein sequence and structural properties (EXPASY, PDB, PDBSUM) / Protein structure prediction software
4	Measurement of protein secondary structure by Circular Dichroism and estimation of secondary structure content using prediction algorithms
5-6	Measurement of fluorescence excitation and emission spectra of proteins and determination of thermal stability of proteins (protein unfolding and obtaining thermodynamic stability measurements from either CD/or FL spectroscopy)

6-7	Protein expression in bacteria by IPTG induction (bacterial growth and concentration of IPTG optimization): SDS Page electrophoresis
8-11	Protein Purification using AKTA FPLC (Bacterial protein expression, centrifugation, sonication, dialysis, column chromatography)

Evaluation Scheme: 100% Total Weightage for Max 200 Marks

Evaluation Component	Duration	Weightage (%)	Date & Time	Remarks
Test 1	30 min	15% (30 Marks)		Open Book
Test 2	30 min	15% (30 Marks)		Open Book
Test 3	30 min	15% (30 Marks)		Open Book
Lab component (Viva, Lab Record/Assignment/Presentation/	During Lab hours	25%(50 Marks)	During the semester	Open Book
Comprehensive examination	120 min	30% (60 Marks)	12/12 FN	Open Book

6.Chamber Consultation hour (Virtual): Will be announced in the Class following discussion and mutual consent.

7. Notices: All noticesconcerning the course will be displayed on the course pages of CMS or through emails.

8. Grading policy: Award of grades will be guided in general by the histogram of marks. Decision on border line cases will be taken based on attendance in classes, students sincerity/efforts to learn and overall Instructor's assessment. Students missing one or more component of evaluation completely may be given NC.

9. Make-up policy: Only for genuine cases - with proper evidence or with prior permission. No Make-up for experiments. I/C's decision will be final.

10. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE
BIO G651