Subject:	BIOL
Course Number:	79
Descriptive Title:	Biotechnology B: Proteins and other Biomolecules
Division:	Natural Sciences
Department:	Biology
Course Disciplines:	Biology, Biotechnology
Catalog Description:	This course provides students with the fundamental skills in applied biotechnology necessary for any biotechnology laboratory but particularly focused on downstream manufacturing processes in biomanufacturing. Skills include the development and maintenance of an industry standard notebook, preparation and sterilization of solutions, reagents and media, utilization of good aseptic technique, proper use and maintenance of laboratory equipment, adherence to quality control protocols, lab safety regulations, in vitro translation, large scale expression, purification, modification, western blot analysis, enzyme-linked immunosorbent assay (ELISA), antibody tagging, and fluorescent microscopy.
Prerequisite:	BIOL 77 Biotechnology A: Basic Lab Skills with a minimum grade of C
Co-requisite:	None
Recommended Preparation:	None
Enrollment Limitation:	None
Hours Lecture (per week):	3
Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Course Hours:	108
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Fall 2023
Transfer UC:	No
Effective Date:	
General Education ECC:	
Term:	
Other:	
CSU GE:	
Term:	
Other:	

IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**1.SLO #1 Knowledge:** Students will be able to demonstrate knowledge of protein production and purification **2. SLO #2 Scientific Communication:** Students will be able to write and follow Standard Operating Procedures (SOPs) **3. SLO #3 Career Proficiency:** Students will be able to demonstrate how to obtain a purified sample of a genetically engineered protein.
Course Objectives:	1. Assess the proper protocols to ensure laboratory safety and quality of product. 2. Analyze the process of protein production starting with a DNA sequence. 3. Evaluate protein production resulting in quantities suitable for industrial applications and summarize the methods needed for obtaining purified protein product. 4. Assess filtration methodology for protein purification. 5. Differentiate methods for identifying and purifying proteins using linkages to other proteins, including antibodies. Describe modifications made to proteins after translation in order to achieve functionality. 6. Examine protein location using fluorescent microscopy. 7. Organize the procedures necessary to ensure safety and quality product production in the laboratory. 8. Diagram the process of protein production starting with a DNA sequence, including the methods used in industry for protein production. 9. Choose the methods needed for obtaining purified protein product and analyzing yield.
Major Topics:	**I. Standard Operating Procedures (SOP) for safety and quality control (Lecture, 5 hours)** A. Personal protective equipment requirements and other safety requirements B. SOPs and integration of quality control C. SOP for operating fast performance liquid chromatography equipment D. SOP for protein extractions E. SOP for buffer preparation **II. Transcription and translation (Lecture, 4 hours)** A. Operon structure including discussion of DNA B. Induction of protein synthesis in transformed cells C. Expression vectors D. Qualitative assessment of protein products **III. Large scale protein expression and bioreactors (Lecture, 10 hours)** A. Bioreactor systems B. Sterilization and preparation for scale up **IV. Protein purification and filtration (Lecture, 10 hours)** A. Types of column chromatography

	B. Separation buffers and media C. Determining yield and purity **V. Post-translational modifications (Lecture, 6 hours)** A. Eukaryotic systems B. Types of modifications C. Functional assays **VI. Protein and antibody tags (Lecture, 6 hours)** A. Types of tags for identification B. Detection methods **VII. Western blot analysis and Enzyme-linked Immunosorbent Assays (ELISAs) (Lecture, 8 hours)** A. Equipment and procedure for Western blot B. Analysis of Western blot results C. Application for Western Blot D. Equipment and procedure for ELISA E. Analysis of ELISA results F. Application for ELISA **VIII. Fluorescent Microscopy (Lecture, 5 hours)** A. Types of fluorescent dyes B. Applications for fluorescent microscopy A minimum of 80% of lab hours involve hands-on activities. **IX. Laboratory exercises (Lab, 54 hours)** A. Lab Standard Operating Procedures (SOP) for safety and quality control B. Protein expression C. Various expression systems (expression vectors) D. Plasmids E. Solution and sample preparation for protein purification F. Protein purification: column chromatography and liquid chromatography G. PCR in terms of amplifying DNA H. Analysis of purity and yields of protein I. Western blots J. One or more of the following: SDS PAGE, translation, protein and antibody tags, fluorescent microscopy, post translational modification of proteins, Enzyme-linked immunosorbent assay (ELISA)
Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108

Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Maintain an industry standard notebook. Include the procedures, observations, relevant thought processes,and data. Analyze the results and develop conclusions.
Critical Thinking Assignment 1:	In a paragraph, describe the visualization of protein location using fluorescent microscopy.
Critical Thinking Assignment 2:	In the presence of the instructor, demonstrate the methods needed for obtaining purified protein product and analyzing yield.
Other Evaluation Methods:	Completion, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Other Exams, Quizzes, Reading Reports, Term or Other Papers, True/False, Written Homework
If Other:	
Instructional Methods:	Demonstration, Discussion, Field trips, Group Activities, Guest Speakers, Lab, Lecture, Multimedia presentations, Role play/simulation
If other:	
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Fundamentals of Protein Structure and Function, 2nd edition, 2015, Buxbaum, Springer, ISBN-13 : 978-3319199191 Discipline Standard
Alternative Textbooks:	None
Required Supplementary Readings:	None
Other Required Materials:	None
Requisite	
Category	
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	None
Requisite Skill and Matching skill(s): Bold the requisite skill(s). if applicable	None
Requisite course:	None
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding	None

course objective under each skill(s).	
Requisite Skill:	None
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). if applicable	None
Enrollment Limitations and Category:	None
Enrollment Limitations Impact:	None
Course Created by:	Mia Dobbs
Date:	12/07/2021
Board Approved:	6/20/2022