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**BIOENGINEERING 753**

Proteins as Engineering Materials, Machines, and Devices

Spring Quarter, 1989 - 3 credit hours

M W F - 7:45 AM - Room MEB 3110

Professor: J. D. Andrade  
Visiting Professor, V. Hlady

Office: 2480 MEB Phone: 581-4379  
Office: 3563 MEB Phone: 581-5042

Course Objective: To introduce graduate and advanced undergraduate students in engineering, science, and pharmacy, to the many and varied functions of proteins and to consider and develop non-biomedical applications for proteins.

Text: T. Creighton, Proteins, Freeman and Co., 1984

Handouts: Available via Kinko's Copies.

Reserve Books: See attached List.

Grading: Midterm Exam - 20%  
Final Exam - 25%  
Project 1 - A Protein - 25%  
Project 2 - Applications - 25%  
Seminars and Discussion - 5%

Projects - Each student will be assigned a protein or class of proteins to review and present. Project 1 will present their proteins, properties, and biological functions. Project 2 will suggest and present potential engineering applications. Each project will consist of a 12 page (maximum) written report and a 5-minute oral report to the class.

Seminars - Students are required to attend, summarize, and critique at least 5 seminars during the quarter. Suitable seminars will be announced in class.

Lecture Topic Schedule (Tentative)

Mon	3/27	Introduction (background/objectives/examples)
Wed	3/29	The Forces of Nature/Scaling/why Nanomachines?
Fri	3/31	Protein Structure and Conformation--Computer Graphics
Mon	4/3	Conformational Adaption and Change
Wed	4/5	Proteins at Interfaces--Adsorption
Fri	4/7	Proteins as Surfactants (membrane penetration, lung surfactant)
Mon	4/10	Aggregation and Crystallization/Proteins in Fields
Wed	4/12	Molecular Recognition and Sensing
Fri	4/14	Bioenergetics
Mon	4/17	Conformational work.
Wed	4/19	Enzymes Mechanisms and Processes - V. Hlady
Fri	4/21	Co-Factors, Ligands, <u>Fuels</u> , and Regulators - V. Hlady

Mon 4/24 Coupled Enzyme Systems/Enzyme Cascades - V. Hlady  
 Wed 4/26 Midterm Examination  
 Fri 4/28 Protein Presentations  
 Mon 5/1 Protein Presentations  
 Wed 5/3 Proteins as Structural Materials - Fibers and Sheets  
 Fri 5/5 Patterns, Masks, and Membranes  
 Mon 5/8 Frost and Heat Resistance  
 Wed 5/10 Molecular Muscles and Conveyors  
 Fri 5/12 Molecular Oars, Paddles, and Rotors  
 Mon 5/15 Proteins as Carriers and Transporters  
 Wed 5/17 Protein Lighting - Bioluminescence  
 Fri 5/19 Photon Counters - Photo Receptors  
 Mon 5/22 Proteins as Sensors and Separators - Antibodies  
 Wed 5/24 Proteins as Sensors and Separators - Enzymes  
 Fri 5/26 Other Sensing Systems - POISONS - TOXINS - VIRUSES - LECTINS  
 Wed 6/2 Protein Writing, Printing, and Manipulation - Direct Observation of  
 Protein Processes - STM/AFM  
 Mon 6/5 Application Presentations  
 Wed 6/7 Application Presentations  
 Fri 6/9 Protein Engineering and Optimization/Projections/Review

Final Examination:

Wednesday, June 7

7:45 - 9:45 AM

Room 3110 MEB

JDA/366/cf

UNIVERSITY OF UTAH LIBRARIES  
RESERVE BOOK REQUEST

*Dr. Kelso & Geis*

Instructor Andrade Date 3-10-89 Course & Course No. BioEng. 753  
 Campus Address 2480 MEB Estimated Number of Students in Class 20  
 Telephone Extension 4379 Quarter or Quarters on Reserve (circle below)

A W (Sp) 89 Su DC

Call Number	Author	Title	Loan Period		Cop. on Res.	Notes
			2 hr.	24 hr.		
QH 611 C97 1987	Bereiter-Hahn, et al	Cytomechanics		x	1	
QH 510 B54 1983	Blumenfeld	Physics of Bioenergetic Process		x	1	
QP 551 C737 1983	Creighton	Proteins	x			recalled
QH 581.2 D43 1984 v.1 or v.2	de Duve	A Guided Tour of the Living Cell		x	1	v.2 - search
QH 510 H37 1986	Harold	The Vital Force: A Study of Bioenergetics		x	1	
QH 505 B47613 1983	Hoppe, et al.	Biophysics		x		recalled
QH 647 L33 1986	Lackie	Cell Movement and Cell Behaviour		x	1	
QP 551 S4255	Schulz & Schirmer	Principles of Protein Structure	x		1	
QP 88.23 S55 1987	Silver	Biological Materials		x	1	
	Stryer	Biochemistry - 1988 ed.		x		ordered
QP 303 M4 1976	Wainwright, et al.	Mechanical Design in Organisms		x		recalled

Key to Note Abbreviations:

- Bindery: Item is being bound & has been requested for Reserve.
- Cop. on Res.: Number of copies on Reserve.
- NIL: Library does not own book but will order if notified by Professor.
- On Order: Book has been ordered for Reserve.
- Out-of-Print: Book is no longer in print. We will place an out-of-print search if notified by Professor.
- Recalled: Book called in from borrower.
- Search: Book can not be found and is being searched.

Bioengineering 753

Proteins as Engineering Machines,  
Materials, and Devices

Spring quarter, 1989, 3 credit hours  
First meeting: 7:45 AM, MEB 3110  
Professor: J.D. Andrade,  
Rm. 2480 MEB, Phone 581-4379

Course Objective

To introduce graduate and advanced undergraduate students in engineering, science, and pharmacy, to the many and varied functions of proteins and to consider and develop non-biomedical applications for proteins.

Prerequisites - Consent of the instructor.

Text - (recommended): Schulz and Schirmer, Principles of Protein Structure

Reserve Books: Stryer, Creighton, deDuve

Exams:

Midterm.....	25%
Final.....	30%
Project Report - written.....	10%
Oral - 10 min.....	10%
Poster session.....	20%
Seminar & Discussion.....	5

Tentative Topic Outline

- Protein Chemistry
- Protein Structure
- Protein Production
- Proteins at Interfaces
- Proteins in "Unusual" Environments
- Self Assembly of Protein Structures and Devices
- Proteins as Structural and Geometric Materials
- Proteins as Interfacial Agents: Nucleators, Antinucleators, Surfactants, etc.
- Recognition Machines and Sensors: Antibodies and Receptor,
- Chemical Machines - Enzymes
- Light Detection - Photoreceptors and Vision
- Light Production - Bioluminescence
- Motion and Activation
  - Muscle
  - Cilia
  - Flagella
  - Rotary Motion
  - Protein Motors
- Project Reports
- Protein Engineering and Biotechnology
- The Future?

Bioengineering 753 Spring '89 Term Projects

Cellulose and Cellulases

Muscle Proteins and an Actomyosin Motor

Bacteriorhodopsin: The Light Driven Proton Pump of  
Halobacterium halobium

Elastin and Elastase

Collagen Structure and Its Applications

Acetylcholine Receptor

Protein Toxins

Proteolytic Enzyme as a Chemical Machine in the Food Industry

Dynein, the Protein Involved in Ciliary and Flagellar  
Motility

Phycobiliproteins: Structure, Function, and Applications

2 copies

BIOENGINEERING 753

Proteins as Engineering Materials, Machines, and Devices

Spring Quarter, 1989 - 3 credit hours

M W F - 7:45 AM - Room MEB 3110

Professor: J. D. Andrade  
Visiting Professor, V. Hlady

Office: 2480 MEB Phone: 581-4559  
Office: 3563 MEB Phone: 581-5042

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graphs

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Protein Projects

- 5/24 Zhang, Hong: Muscle Proteins  
actin, myosin, troponin, motion, actuation, motors?
- 5/31 Hosakul, Amphorn: Acetylcholine Receptor and Acetylcholinesterase  
biosensors, nerve agent defense
- 5/31 Lea, Scott: Phycobiliproteins  
energy conversion, sensors, and diagnostics
- 5/31 Bruckner-Lea, Cindy: Smell / Taste Receptors OR Bacteriorhodopsin  
Sensing, energy transduction
- 6/2 Ho, Chih-hu: Elastin and Elastase  
elastic materials
- 5/31 Li, Jemgthun: Proteolytic Enzymes  
foods and biotechnology industries
- Gower, Laurie: Ion-Binding Proteins and Domains  
detoxification  
water purification, regulation, sensing,
- 5/24 Bakhtian, Sherry: Bacterial Flagella  
rotary motion, propulsion
- 5/31 Marra, Michelle: Protein Toxins  
poisons, sensors, antivenoms
- 6/2 Li, Jianmin: Collagens and Collagenases  
structures and materials, purification
- 6/2 Tripp, Brian: Cellulases and Cellulose  
biomass conversion, waste disposal

JDA/cp/t4