

<b>ORIGINATOR'S SECTION:</b>														
<b>1. College:</b> <input type="checkbox"/> CHABSS <input type="checkbox"/> CoBA <input type="checkbox"/> CoEHHS <input checked="" type="checkbox"/> CSM	<b>Desired Term and Year of Implementation (e.g., Fall 2008):</b> Fall 2018													
<b>2. Course is to be considered for G.E.? (If yes, also fill out appropriate GE form*)</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No														
<b>3. Course will be a variable-topics (generic) course?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No ("generic" is a placeholder for topics)														
<b>4. Course abbreviation and Number:*</b> CHEM 553														
<b>5. Title: (Titles using jargon, slang, copyrighted names, trade names, or any non-essential punctuation may not be used.)</b> <u>Membrane Protein Biophysics</u>														
<b>6. Abbreviated Title for PeopleSoft:</b> (no more than 25 characters, including spaces) Mem. Prot. Biophysics														
<b>7. Number of Units:</b> 2														
<b>8. Catalog Description: (Not to exceed 80 words; language should conform to catalog copy. Please consult the catalog for models of style and format; include all necessary information regarding consent for enrollment, pre- and/or corequisites, repeated enrollment, crosslisting, as detailed below. Such information does <u>not</u> count toward the 80-word limit.)</b>  Introduces the principles that govern the structure and function of membrane proteins. Different classes of membrane proteins will be discussed using examples that play important roles in human health and disease. <i>Prerequisites: A minimum grade of C (2.0) in CHEM 341 or 351 or classified graduate standing.</i>														
<b>9. Why is this course being proposed?</b>  This course is being proposed as part of the new Masters in Chemistry program. CHEM 553 will serve as an elective course in the option in biochemistry.														
<b>10. Mode of Instruction*</b> For definitions of the Course Classification Numbers: <a href="http://www.csusm.edu/academic_programs/curriculumscheduling/catalogcurricula/DOCUMENTS/Curricular_Forms_Tab/Instructional%20Mode%20Conventions.pdf">http://www.csusm.edu/academic_programs/curriculumscheduling/catalogcurricula/DOCUMENTS/Curricular_Forms_Tab/Instructional%20Mode%20Conventions.pdf</a>														
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Type of Instruction</th> <th style="text-align: center;">Number of Credit Units</th> <th style="text-align: left;">Instructional Mode (Course Classification Number)</th> </tr> </thead> <tbody> <tr> <td>Lecture</td> <td style="text-align: center;">2</td> <td>C-2</td> </tr> <tr> <td>Activity</td> <td></td> <td></td> </tr> <tr> <td>Lab</td> <td></td> <td></td> </tr> </tbody> </table>	Type of Instruction	Number of Credit Units	Instructional Mode (Course Classification Number)	Lecture	2	C-2	Activity			Lab		
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Lecture	2	C-2												
Activity														
Lab														
<b>11. Grading Method:*</b> <input checked="" type="checkbox"/> Normal (N) (Allows Letter Grade +/-, and Credit/No Credit) <input type="checkbox"/> Normal Plus Report-in-Progress (NP) (Allows Letter Grade +/-, Credit/No Credit, and Report-in-Progress) <input type="checkbox"/> Credit/No Credit Only (C) <input type="checkbox"/> Credit/No Credit or Report-in-Progress Only (CP)														
<b>12. If the (NP) or (CP) grading system was selected, please explain the need for this grade option.</b>  														
<b>13. Course Requires Consent for Enrollment?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  <input type="checkbox"/> Faculty <input type="checkbox"/> Credential Analyst <input type="checkbox"/> Dean <input type="checkbox"/> Program/Department - Director/Chair														
<b>14. Course Can be Taken for Credit More than Once?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many times?                      (including first offering)														
<b>15. Is Course Crosslisted:</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  If yes, indicate which course                      and check "yes" in item #22 below.														
<b>16. Prerequisite(s):</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No                      CHEM 341 or CHEM 351 or classified graduate standing.														

\* If Originator is uncertain of this entry, please consult with Program/Department Director/Chair.

16. Prerequisite(s): ☒ Yes ☐ No ~~CHEM 1341 or CHEM 1351~~

17. Corequisite(s): ☐ Yes ☒ No

18. Documentation attached:  
☐ Syllabus ☒ Detailed Course Outline

19. If this course has been offered as a topic, please enter topic abbreviation, number, and suffix:\*

20. How often will this course be offered once established?\* Once a Year

**PROGRAM DIRECTOR/CHAIR - COLLEGE CURRICULUM COMMITTEE SECTION:**  
*(Mandatory information – all items in this section must be completed.)*

21. Does this course fulfill a requirement for any major (i.e., core course or elective for a major, majors in other departments, minors in other departments)? ☒ Yes ☐ No

If yes, please specify:  
 Elective course in the Masters of Science in Chemistry

22. Does this course impact other discipline(s)? (If there is any uncertainty as to whether a particular discipline is affected, check "yes" and obtain signature.) ☐ Yes ☒ No

If yes, obtain signature(s). Any objections should be stated in writing and attached to this form.

Discipline	_____	_____	_____ Support	_____ Oppose
	Signature	Date		
Discipline	_____	_____	_____ Support	_____ Oppose
	Signature	Date		

**SIGNATURES : (COLLEGE LEVEL) :**

Saiith Jayasinghe

1. Originator (please print or type name) \_\_\_\_\_ Date 12/2/16

2. Program Director/Chair \_\_\_\_\_ Date 12/14/16

3. College Curriculum Committee \_\_\_\_\_ Date 12/14/16

4. College Dean (or Designee) \_\_\_\_\_ Date \_\_\_\_\_

**(UNIVERSITY LEVEL)**

5. UCC Committee Chair \_\_\_\_\_ Date \_\_\_\_\_

6. Vice President for Academic Affairs (or Designee) \_\_\_\_\_ Date \_\_\_\_\_

7. President (or Designee) \_\_\_\_\_ Date \_\_\_\_\_

RP Tracker ✓

**CHEMISTRY 553: Membrane Protein Biophysics**

Term: TBD  
Prerequisites: CHEM 341 or 351  
Class time: TBD  
Class location: TBD  
Instructor: S. Jayasinghe (Jay), Ph.D.  
Inst. Office: TBD  
Inst. Office hours: TBD  
Inst. Phone: (760) 750-8075  
Inst. E-mail: sjayasin@csusm.edu

**Course Description:** Introduces the principles that govern the structure and function of membrane proteins. Different classes of membrane proteins will be discussed using examples that play important roles in human health and disease.

**Student Learning Outcomes:**

Upon completion of this course students should:

- (1). Be able to describe the difference between soluble and membrane proteins, be able to describe the importance of membrane proteins in health and disease, and be able to describe important structural and sequence features of membrane proteins.
- (2). Be able to identify the various classes of membrane proteins, and be able to describe the differences between them.

**Textbook:** No required textbook. We will refer to 'Biochemistry' by Garrett and Grisham as the need arises (especially in the introductory/review sections).

**Readings:** Course discussion will focus on relevant articles from the literature and on relevant chapters from 'Biochemistry' by Garrett and Grisham.

**Topic Schedule: Week 1 Introduction to the course**

Introduction to the Protein Data Bank (PDB)  
Introduction to Visual Molecular Dynamics (VMD)

**Readings:**

- (1). 'VMD Molecular Graphics' – by the University of Illinois at Urbana Champaign
- (2). 'Visualizing Molecules with VMD' – by Christoph Weber.
- (3). 'A short guide to the Visualization of Membrane Protein systems using Visual Molecular Dynamics (VMD)' – by Alfredo Freitas.

**Week 2 Review of protein structure and protein folding**

**Readings:**

- (1). Chapter 4 (4.1, 4.2); Chapter 5 ( 5.1, 5.2, 5.8, 5.9); Chapter 6 (6.1, 6.2, 6.3, 6.4) of Garrett and Grisham.
- (2). Dobson, C.M., The structural basis of protein folding and its link to human disease, *Philos. Trans. R. Soc. Lond. B. Biol. Sci.*, **356**(1406), 133-145.

**Week 3 Review of lipids and lipid membranes**

Readings:

(1). Chapter 8 (8.1, 8.2, 8.3, 8.4); Chapter 9 (9.1) of Garrett and Grisham.

(2). Vereb, G., *et.al.*, Dynamic, yet structured: The cell membrane three decades after the Singer-Nicolson model, *PNAS*, 100(14), 8053-8058.

**Week 4**

The folding of membrane proteins

**Classification of membrane proteins**

Readings:

(1). Chapter 9 (9.2) of Garrett and Grisham.

(2). White, S.H., and von Heijine, G., The machinery of membrane protein assembly, *Curr. Opin. Struct. Biol.*, **14**, 397-404.

(3). White, S.H., *et.al.*, How Membranes Shape Protein Structure, *JBC*, **276**(35), 32395-32398.

(4). White, S.H., Translocons, thermodynamics, and the folding of membrane proteins, *FEBS Lett.*, **555**, 116-121.

**Week 5**

**Membrane Proteins of Known Structure  
Identification of Membrane proteins**

Readings:

(1). Jayasinghe, S., Hristova, K., and White, S.H., Mptopo: A database of membrane protein topology, *Prot. Sci.*, **10**, 455-458.

(2). [http://blanco.biomol.uci.edu/Membrane\\_Proteins\\_xtal.html](http://blanco.biomol.uci.edu/Membrane_Proteins_xtal.html)

**Week 6**

**Ion Channels and Pumps**

Readings:

(1). Dworakowska, B., and Dolowy, K., Ion Channels-related diseases, *Acta Biochimica Polonica*, **47**(3), 685-703.

(2). Yu, F.H., Yarov-Yarovoy, V., Gutman, G.A., and Catterall, W.A., Overview of Molecular Relationships in the Voltage-Gated Ion Channel Superfamily, *Pharmacol. Rev.*, **57**(4), 387-395.

(3). MacKinnon, R., Potassium Channels, *FEBS Letters*, **555**, 62-65.

**Week 7**

**Ion Channels and Pumps Cont...**

Readings:

(1). Yu, F.H., and catterall, W.A., Overview of the voltage-gated sodium channel family, *Genome Biology*, **4**(3), 207.

(2). Jentsch, T.J., Maritzen, T., and Zdebik, A.A., Chloride channel diseases resulting from impaired transepithelial transport or vesicular function, *J. Clin. Invest.*, **115**(8), 2039-2046.

**Week 8****Other Channels**

BtuB: the Cobalamine Transporter

Readings:

- (1). Agre, P., The Aquaporin Water Channels, *Proc. Am. Thorac. Soc.*, **3**(1), 5-13.
- (2). Yasui, M., Molecular Mechanisms and Drug Development in Aquaporin Water Channel Diseases: Structure and Function of Aquaporins, *J. Pharmacol. Sci.*, **96**, 260-263.
- (3). Chimento, D.P., Mohanty, A.k., Kadner, R.J., Wiener, M.C., Substrate-induced transmembrane signaling in the cobalamin transporter BtuB, *Nat. Struct. Biol.*, **10**(5), 394-401.

**Week 9****G-Protein Coupled Receptors**

Readings:

- (1). Ballesteros, J., and Palczewski, K., G protein-coupled receptor drug discovery: Implications from the crystal structure of rhodopsin, *Curr. Opin. Drug Discov. Devel.*, **4**(5), 561-574.
- (2). Rhodopsin: Structural basis of molecular physiology, *Physiol. Rev.*, **81**(4), 1659-1688.

**Week 10****No Class – Spring Break****Week 11****Peripheral membrane Proteins**

Readings:

- (1). Overduin, M., Cheever, M.L., and Kutateladze, T.G., Signaling with phosphoinositides: better than binary, *Mol. Interv.*, **1**(3), 150-159.
- (2). Prestwich, G.D., Phosphoinositide signaling: From Affinity Probes to Pharmaceutical Targets, *Chemistry & Biology*, **11**, 619-637.
- (3). Legendre-Guillemin, V., Wasiak, S., Hussain, N.K., Angers, A., McPherson, P.S., ENTH/ANTH proteins and clathrin-mediated membrane budding, *J. Cell Sci.*, **117**(Pt 1), 9-18.

**Week 12****Toxins**

Reading:

- (1). Montoya, M., and Gouaux, E.,  $\beta$ -Barrel membrane protein folding and structure viewed through the lens of  $\alpha$ -hemolysin, *Biochim. Biophys. Acta*, **1609**, 19-27.

**Week 13****Diseases of Protein Misfolding (Alzheimer's, Type II Diabetes): Implications of polypeptide membrane interactions.**

Reading:

- (1). Kaye, R., et.al., Permeabilization of lipid bilayers is a common conformation-dependent activity of soluble amyloid oligomers in protein misfolding diseases, *J. Biol. Chem.*, **279**(45), 46363-46366.

**Week 14****Presentations**

## **Week 15      Presentations**

**5/07/07 Last day of Class: Projects Due**

**Course web site:**      TBD

**In Class presentations:** Working in groups, students will lead class discussion on the following topics: Ion, and other, channels, G-protein coupled receptors, peripheral membrane proteins, toxins, and diseases of protein misfolding.

Students will be responsible for reading the assigned reports (see above), summarizing the information, and presenting this information to the class. Students are encouraged to read and integrate additional information from the primary literature as needed. Student presentations should (at least) include the following information:

Importance of the particular class of membrane protein (to human health) –  
Background information

Current understanding of the structural details of members of the class of  
membrane protein – Are 3D structures available? How were they obtained?  
Number of TM segments, Helical?

Structural features that play critical roles in the function of the class of membrane  
protein – Critical residues, in the case of channels selectivity filters etc.

All members of a team must participate in the presentation.

**Semester Project:**      TBD

<b>Grading (points):</b>	Mid Term Examinationa (2 @ 50 points each	100
	Final Exmination	50
	In class presentations	25
	Final project	25

**Writing Requirement:** The University Writing Requirement will be satisfied upon successful completion of the final project.

**Students with Disabilities:**      Students with disabilities who require accommodation must be approved by the Office of Disabled Student Services (DSS). Please contact this office as soon as possible and should meet with the instructor during office hours (or at some other mutually agreeable time). The DSS office is located in Craven hall 5205. Their telephone number is (760) 750-4905 or TTY (760) 750-4909.

**Academic Honesty:**      All students are expected to maintain academic honesty. **All submitted work must be your own and must be written in your own words.**

All students should be familiar with the university policies and procedures concerning academic honesty as detailed in the university catalog. An online version of these polices and procedures can also be found at:  
[http://lynx.csusm.edu/policies/procedure\\_online.asp?ID=187](http://lynx.csusm.edu/policies/procedure_online.asp?ID=187)