1. **Course number and name - CHBE 4310 – Bioprocess Engineering**
   (selected elective; required for biotechnology option)

2. **Credits and contact hours** - 3 credit hours, 3 lecture hours (3-0-0-3)

3. **Instructor's or course coordinator's name -** Dr. Rachel Chen

4. **Textbook, title, author, and year**
   "Bioprocessing Engineering, Basic Concepts" (2nd edition), Shuler, Kargi and DeLisa, 2017.

5. **Specific course information**
   a. **Catalog Description –** Integrating several ChBE core concepts, bioprocess engineering applies the engineering principles to biological systems. Topics covered include enzyme kinetics, fermentation, downstream processing and integrated bioprocesses important to biotech industries
   b. **Prerequisites or co-requisites** –CHBE 4300 Kinetics and Reactor Design (grade "C" or better); CHEM 3511 Survey of Biocgemistry OR CHEM 4511 Biochemistry I.
   c. **Required, elective, or selected elective course** (as per Table 5-1) – Required (biotech option); selected elective (standard option)

6. **Specific goals for the course**
   a. **Specific outcomes of instruction**:
   By the end of this course, a student should be able to:
      1) Use correct biological terms to describe and analyze phenomena/problems in bioprocesses
      2) Explain major differences between different cell types (such as Gram-negative/Gram-positive bacteria, simple eukaryotes vs. mammalian cells) and their respective cell growth requirements in bioprocesses
      3) Explain how environmental conditions influence cell growth and means to achieve optimal cell growth in large scale
      4) Analyze kinetics of cell growth or enzyme-catalyzed reactions and identify limiting factors
      5) Design or Select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria
      6) Design a suitable scheme of bioproduct separations based upon the molecular characteristics of the product and other process criteria
      7) Analyze major metabolic pathways and identify common regulatory mechanisms
      8) Analyze molecular biology elements used to construct recombinant cell lines and identify potential genetic instability in bioprocesses

b. **Connection with Student Outcomes**

CHBE 4310							
	Student Outcomes						
Course Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1	**X**						
Course Outcome 2	**X**	**X**					
Course Outcome 3	**X**	**X**					
Course Outcome 4	**X**	**X**					
Course Outcome 5	**X**	**X**		**X**			
Course Outcome 6	**X**	**X**					
Course Outcome 7	**X**	**X**		**X**		**X**	
Course Outcome 8	**X**					**X**	**X**

Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

(3) an ability to communicate effectively with a range of audiences

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7. **Brief list of topics to be covered**
   a. Overview of biotechnology industry
   b. Organisms of biotechnological importance
   c. Enzymes and applications
   d. Metabolic pathways
   e. Microbial growth
   f. Stoichiometry and application in bioprocesses
   g. Expression of a gene in a heterologous host
   h. Making recombinant protein
   i. Regulation in gene expression and metabolism
   j. Using genetically engineered organisms in bioprocesses
   k. Bioreactors for enzymatic and microbial processes
   l. Bioseparation and product purification
   m. Mammalian cell culture and bioreactors
   n. Plant cell culture
   o. Industrial process analysis
   p. Regulatory issues in biopharmaceutical industry