


Fundamentals of Microbial Cell Biotransformations

[Syllabus-FMCB.pdf](#)

Course #	MB 420/520	
Semester	Fall 2011	
Instructor	José Manuel Bruno-Bárcena 4554 Thomas Hall North Carolina State University Raleigh, NC 27695	Phone: 919-513-1495 Fax: 919-515-7867 email: jbbarcen@ncsu.edu Web Site: http://www4.ncsu.edu/~jbbarcen
Requisite	Pre-requisite MB 352	
Credit Hours	2	
Restrictions	Students who have completed MB 420 may not take MB 520 for credit. Electronic devices are required to be turned off in the classroom.	
GEP Status	None	
Location	Room 4508 Thomas Hall	
Date	October 11 th - December 15 th	
Class Hours	Lecture - Tuesdays, 12:50 PM -2:40 PM Laboratory - Time 520 PM- 10:15 PM <ul style="list-style-type: none"> • Wednesdays, Section MB 420L/520L Time 1250 PM- 550 PM • Thursdays, Section MB 420L/520L Room # Small scale Fermentation Lab Thomas Hall Building 	
Office Hours	Tuesday, 14:50-15:30	
Course Website	http://moodle.wolfware.ncsu.edu/	
Delivery Format	This is a half-semester class. Students are required to attend weekly lectures and laboratories during the weeks the course is taught.	
Course Description	This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors.	
Technology Requirements	In order to complete the course, all students will be required to have access to an active internet connection. If you do not have Adobe Acrobat Reader installed on your computer, you will need to go to the following web site and follow the instructions to download a free version. http://www.adobe.com/products/acrobat/readstep2.html	
Course Structure	This course will consist of two blocks of Lecture and Laboratory. Each of the blocks will cover theory and practice of fermentation at bench scale. After completion of each laboratory experience students will be required to submit written reports describing objectives of the laboratory exercise, detailed experimental procedures, and results and discussion of the experiment. During the course of the semester students will be regularly tested on their understanding of the theoretical portion of the laboratory (text book reading assignments and additional reading assignments provided by instructor) in form of quizzes (35% of total grade). Each student will be evaluated on their laboratory safety, laboratory skills, and individual documentation skills (25% of total grade). At the end of the course students will complete a final exam that will cover all the topics discussed during the course (40% of total grade). Students taking MB 520 will have the additional requirement of a major term paper. The subject of this final paper will be to search and select from the patent database an	

	<p>experimental upstream approach to produce one active pharmaceutical ingredient (API) using cells (GMO or non GMO). The paper should be written following the ASM journal instruction (http://jb.asm.org/misc/ifora.shtml) for authors. It should contain at least five written pages, font 12, single paragraph. The references pages will not be counted as the written pages. The graduate students will be graded as described below.</p>
Text Requirements	<p>All required reading material is contained within the module or is available through a World Wide Web link provided within the module content. At present, all laboratory reading materials will be provided. The class links page is also available as a source of the following references for the module:</p> <p>1. Shuler, M.L., Kargi, F., editors 2002. Bioprocess Engineering: Basic Concepts. Prentice-Hall of India (ISBN0130819085) \$127.00 This reference will also be available in the Reserve Room of the D. H. Hill .Library.</p>
Learning Outcomes	<p>At the end of this course, students will:</p> <ul style="list-style-type: none"> • explain key fundamental biotechnology concepts • interpret culturing processes used in traditional and in modern biotechnology; • demonstrate laboratory and cell culture techniques using small scale bioreactors while observing standard safety practices • interpret and explain results of laboratory experiments as well as demonstrate the importance of the interdisciplinary effort required for product development
Lecture Outlines by Topical Areas	<p>Week 1. History of traditional and modern biotechnology. Pure culture philosophy– <i>Reading assignment provided by the instructor. Quiz #1</i></p> <p>Week 2. Cell Nutrition – <i>Reading assignment provided by the instructor. Quiz #2</i></p> <p>Week 3. Microbial cell culture and selecting the cultivation system – <i>Reading assignment provided by the instructor. Quiz #3</i></p> <p>Week 4. Elemental composition and stoichiometry of cells – <i>Reading assignment provided by the instructor. Quiz #4</i></p> <p>Week 5. Microbial growth and production rate – <i>Reading assignment provided by the instructor. Quiz #5</i></p> <p>Week 6. Microbial physiology and metabolic control: Adaptability of cells – <i>Reading assignment provided by the instructor. Quiz #6</i></p> <p>Week 7. Introduction to process instrumentation, monitoring and supervision – <i>Reading assignment provided by the instructor. Quiz #7</i></p>
Laboratory Topical Areas	<p>Week 1. Lab safety (equipment & policies). A review of the aseptic and analytical techniques. <i>Reading assignment provided by the instructor. Safety Quiz</i></p> <p>Week 2. Continuous reactor cultures. Sampling and storage. <i>Reading assignment provided by the instructor. Quiz #1</i></p> <p>Week 3. Transitory pulse feed. Glucose repression or Crabtree effect. <i>Reading assignment provided by the instructor. Quiz #2</i></p> <p>Week 4. Setting dilution rate. Substrate, product, and biomass analysis. <i>Reading assignment provided by the instructor. Quiz #3</i></p> <p>Week 5. Calculation of maximum specific growth rate by the wash-out and by unrestricted growth methods. Distribute the stored data of the process from the computer. <i>Reading assignment provided by the instructor. Quiz #4</i></p>

	<p>Week 6. TFF cell harvest and UF/DF step. <i>Reading assignment provided by the instructor</i></p> <p style="text-align: center;">Quiz #5</p> <p>Week 7. Reactor cleaning, Reactor and probe preparation and Control unit set-up for operation. <i>Reading assignment provided by the instructor</i> Quiz #6</p>																																							
<p>Course Grading</p>	<p>For Students Taking MB 520</p> <ol style="list-style-type: none"> 1. Weekly Lab quizzes (10 questions/15 minutes) and Lab reports (25%) 2. Skills demonstration and Notebook organization (20%) 3. Research Paper (25%) 4. Final Test (30%) <p>Attendance at ALL laboratories is mandatory and unexcused absence from lab will result in failure of the course. Lecture attendance is also required and non-attendance will result in a reduction of 10 points in the final grade.</p> <p>Students are not allowed to take this course for "credit only". In order to receive recognition for an audit, graduate students are required to complete all assignments and earn a grade of C- or better. Conversion from letter grading to audit grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details, refer to http://www.ncsu.edu/policies/academic_affairs/pol_reg/REG205.00.5.php</p>																																							
<p>Grading Scale</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 15%;">A+</td><td style="width: 10%;">=</td><td style="width: 75%;">97.0-100%</td></tr> <tr><td>A</td><td>=</td><td>92.0-96.9%</td></tr> <tr><td>A-</td><td>=</td><td>89.0-91.9%</td></tr> <tr><td>B+</td><td>=</td><td>86.0-88.9%</td></tr> <tr><td>B</td><td>=</td><td>82.0-85.9%</td></tr> <tr><td>B-</td><td>=</td><td>79.0-81.9 %</td></tr> <tr><td>C+</td><td>=</td><td>76.0-78.9%</td></tr> <tr><td>C</td><td>=</td><td>72.0-75.9%</td></tr> <tr><td>C-</td><td>=</td><td>69.0-71.9%</td></tr> <tr><td>D+</td><td>=</td><td>66.0-68.9%</td></tr> <tr><td>D</td><td>=</td><td>62.0-65.9%</td></tr> <tr><td>D-</td><td>=</td><td>59.0-61.9%</td></tr> <tr><td>F</td><td>=</td><td>< 59.0%</td></tr> </table> <div style="text-align: right; margin-top: 10px;">  </div>	A+	=	97.0-100%	A	=	92.0-96.9%	A-	=	89.0-91.9%	B+	=	86.0-88.9%	B	=	82.0-85.9%	B-	=	79.0-81.9 %	C+	=	76.0-78.9%	C	=	72.0-75.9%	C-	=	69.0-71.9%	D+	=	66.0-68.9%	D	=	62.0-65.9%	D-	=	59.0-61.9%	F	=	< 59.0%
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<p>Late Assignments</p>	<p>Late assignments without a valid excuse will not be accepted and will receive a score of zero.</p>																																							
<p>Incomplete Grades</p>	<p>Incomplete as a course grade will be awarded only for work not completed during the course due to conditions deemed by the instructor to be beyond the reasonable control of the student.</p> <p>For undergraduate students, unless an extended deadline is authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The University policy on incomplete grades is located at http://www.ncsu.edu/policies/academic_affairs/grades_undergrad/REG02.50.3.php</p> <p>For graduate students, if an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions) or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The University policy on</p>																																							

	<p>incomplete grades is located at http://www.ncsu.edu/policies/academic_affairs/grades_undergrad/REG02.50.3.php Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.18.F at: http://www.fis.ncsu.edu/grad_publicns/handbook/.</p>
Academic Integrity Statement	<p>It is expected that each student will complete his/her own homework, quizzes, and exams with academic integrity. Students shall follow the NCSU Code of Student Conduct (http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php) In addition, your signature on any test or assignment means that you neither gave nor received unauthorized aid. In other words, your signature on to-be-graded work in this course communicates an understanding of, and adherence to, the University Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."</p>
Attendance Policy	<p>Students are expected to attend class and attendance will be taken. If there is a need to miss class, notify the instructor prior to the class. It is the student's responsibility to obtain assignments and information for any missed classes. For NCSU attendance regulations, refer to the academic policy and regulations website at: http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php</p> <p>Attendance at ALL laboratories is mandatory and unexcused absence from lab will result in failure of the course. Lecture attendance is also required and non-attendance will result in a reduction of 10 points per missed lecture in the final grade.</p>
Laboratory Safety	<p>Each student is expected to observe proper laboratory procedures as outlined in the class instructions for each laboratory period and in the Lab Safety Plan to be presented at the first laboratory meeting.</p>
Students with Disability Policy	<p>Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students (http://www.ncsu.edu/dso/) at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at (http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.1.php)</p>
Anti-Discrimination Statement	<p>NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://www.ncsu.edu/policies/campus_environ or http://www.ncsu.edu/equal_op. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 515-3148."</p>