Course information for

Fundamentals of Microbial Cell Biotransformations

Syllabus-FMCB.pdf

Course #	**MB 420/520**
Semester	Fall 2023
Instructor	José Manuel Bruno-Bárcena 4554 Thomas Hall Addition North Carolina State University Raleigh, NC 27695 Phone: 919-513-1495 Fax: 919-515-7867 email: jbbarcen@ncsu.edu Web Site: https://cals.ncsu.edu/plant-and-microbial-biology/people/jbbarcen/
	Madison Moore 4554 Thomas Hall Addition North Carolina State University Raleigh, NC 27695 Phone: 919-513-3834 Fax: 919-515-7867 email: mklein2@ncsu.edu
Requisite	Pre-requisite MB 352
Credit Hours	2
Restrictions	Students who have completed MB 420 may not take MB 520 for credit.
GEP Status	None
Location	Room 02725 Bostian Hall
Date	October 17th - December 5th, 2023
Class Hours	Lecture -Room 02725 Bostian Hall Tuesdays, 12:50 PM -2:40 PM Laboratory – Room #1518 Small scale Fermentation Lab Thomas Hall Building Thursdays, 12:50 PM- 5:40 PM - Section MB 420L/520L
Office Hours	Tuesday, 14:50-15:30
Course Website	http://wolfware.ncsu.edu/
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	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 This course may require technologies to complete coursework. Be sure to review the syllabus for these expectations and see go.ncsu.edu/syllabus-tech-requirements to find out more about technical requirements for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: https://www.lib.ncsu.edu/devices.
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. Additionally, lab notebooks will be required and graded on completion and organization **at the end of every lab**. During the semester students will be regularly tested on their understanding of the theoretical portion of the laboratory (textbook reading assignments and additional reading assignments provided by instructor) in form of

	quizzes (35% of total grade). Students 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 enrolled in MB 520	Students enrolled in MB 520, students will be required to complete a final project, which will take the form of a research paper due at the end of the semester. To initiate this process, you must develop an outline for your final project and seek approval by week 4 of the course. To obtain approval, schedule a meeting with the course Teaching Assistant (TA). For the research paper, graduate students will be engaged in the following activities: 1. Reading "Pasteur and Modern Science" by René Dubos. This book is available for rent at the NCSU Library (Call Number: Q143 .P2 D79) or can be purchased. 2. Analyzing a U.S. Patent document assigned by the instructor. This analysis will focus on examining claims and utility within the context of bioprocessing, innovation, and discovery. Your final paper should demonstrate the following: 1. A comprehensive understanding of the historical and contemporary significance of bioprocessing in the context of modern science. 2. The ability to critically evaluate U.S. Patent documents related to bioprocessing utility claims. 3. Proficiency in applying bioprocessing principles to real-world scenarios. 4. Effective communication of your findings and perspectives through the comprehensive research paper. Furthermore, your papers should adhere to the formatting guidelines provided by the ASM journal for authors (http://jb.asm.org/misc/ifora.shtml). Papers should consist of a minimum of five written pages, using font size 12 and a single paragraph format. Please note that the reference pages will not be counted as part of the five written pages. Grading for graduate students will be based on the criteria outlined in the course materials. If you have any questions or need further clarification, don't hesitate to reach out to your instructor or TA.
Text Requirements	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: 1. Shuler, M.L., Kargi, F., editors 2002. Bioprocess Engineering: Basic Concepts. Prentice-Hall of India (ISBN0130819085) This reference will also be available in the Reserve Room of the D. H. Hill Library.
Learning Outcomes	At the end of this course, students will: • 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 (Subject to change)	**Week 1**. History of traditional and modern biotechnology. Pure culture philosophy– *Reading assignment provided by the instructor*. **Quiz #1** **Week 2**. Cell Nutrition – *Reading assignment provided by the instructor*. **Quiz #2**

	Week 3. Microbial cell culture and selecting the cultivation system – *Reading assignment provided by the instructor*. **Quiz #3** **Week 4**. Elemental composition and stoichiometry of cells – *Reading assignment provided by the instructor*. **MB 520 students' one-page final project proposal due. Quiz #4** **Week 5**. Microbial growth and production rate – *Reading assignment provided by the instructor*. **Quiz #5** **Week 6**. Microbial physiology and metabolic control: Adaptability of cells – *Reading assignment provided by the instructor*. **Quiz #6** **Week** 7. Introduction to process instrumentation, monitoring and supervision – *Reading assignment provided by the instructor*. **Quiz #7**
Laboratory Topical Areas (Subject to change)	**Week 1**. Lab safety (equipment & policies). A review of the aseptic and analytical techniques. **Safety Quiz** **Week 2**. Continuous reactor cultures. Sampling and storage. **Quiz #1, Notebook Check, Lab 1 Report Due** **Week 3**. Transitory pulse feed. Glucose repression or Crabtree effect. **Quiz #2, Notebook Check, Lab 2 Report Due** **Week 4**. Setting dilution rate. Substrate, product, and biomass analysis. **Quiz #3, Notebook Check, Lab 3 Report Due** **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. **Quiz #4, Notebook Check, Lab 4 Report Due** **Week 6**. TFF cell harvest and UF/DF step. **Quiz #5, Notebook Check, Lab 5 Report Due** **Week 7**. Reactor cleaning, Reactor and probe preparation and Control unit set-up for operation. **Quiz #6, Notebook Turn in, Lab 6 Report Due** **Final Graduate Projects, Final Data Sheets and Lab Notebooks, Final Lab Reports Due at the same time of the Final Exam**
Course Grading	For Students Taking MB 420 1. Weekly Lab quizzes (10 questions/15 minutes) and Lab reports (35%) 2. Skills demonstration and Notebook organization (25%) 3. Final Test (40%) For Students Taking MB 520 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%) 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. Students are not allowed to take this course for "credit only". 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
Grading Scale	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% 
Late Assignments	Late assignments without a valid excuse will not be accepted and will receive a score of zero.
Incomplete Grades	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. **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 **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 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/.
Academic Integrity Statement	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."
Attendance Policy	NC State attendance policies can be found at: https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/ . Please refer to this course's attendance, absence, and deadline policies for additional details. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation. However, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and

	participating section above. COVID 19-related absences will be considered excused; documentation need only involve communication with your instructor.
Laboratory Safety	Due to the Coronavirus pandemic, public health measures have been implemented across campus. Students should stay current with these practices and expectations through the Protect the Pack website (https://www.ncsu.edu/coronavirus/). The sections below provide expectations and conduct related to COVID-19 issues. Each student is expected to observe proper laboratory procedures as outlined below for each laboratory period and in the Lab Safety Plan to be presented at the first laboratory meeting.
Health and Well-Being Resources	These are difficult times, and academic and personal stress is a natural result. Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you: ● Counseling Center (https://counseling.dasa.ncsu.edu/) ● Health Center (https://healthypack.dasa.ncsu.edu/) ● If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: (go.ncsu.edu/NCSUcares). If you or someone you know are experiencing food, housing, or financial insecurity, please see the Pack Essentials Program (https://dasa.ncsu.edu/pack-essentials/).
Community Standards Related to COVID-19	● We are all responsible for protecting ourselves and our community. Please see the community expectations
Students with Disability Policy	Reasonable accommodations will be made for students with verifiable disabilities. 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 *)*
Anti-Discrimination Statement	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."