

Accelerated Master's Degree in Biomanufacturing
(BS CHE Biomanufacturing Concentration/MS BIOM)^{5,6}

Fall Semester	Credit	Spring Semester	Credit
CH 101 (or 103) General Chem I ^{1a}	3	CH 201 (or 203) General Chem II ^{1b}	3
CH 102 (or 104) General Chem I Lab ^{1a}	1	CH 202 (or 204) General Chem II Lab	1
E 101 Intro to Engr & Prob Solv ^{1a}	1	MA 241 Calculus II ^{1a}	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I ^{1a}	3
ENG 101 Academic Writing & Res ^{1a}	4	PY 206 Physics for Engr & Sc I Lab ^{1a}	1
MA 141 Calculus I ^{1a}	4	E102 Engr in the 21 st Century (GEP IP)	2
HESx 1** Fitness & Wellness*	<u>1</u>	HESx (100 or 200 level) Elective*	<u>1</u>
	15		15

Fall Semester	Credit	Spring Semester	Credit
BEC 220 Intro Biomanufacturing	1	BIO 183 Intro Bio: Cellular & Molecular	4
CH 221 (or 225) Organic Chem I ^{1b}	3	CH 223 (or 227) Organic Chem II	3
CH 222 (or 226) Organic Chem I Lab	1	CH 224 (or 228) Organic Chem II Lab	1
CHE 205 Chemical Proc Prin ^{1b}	4	CHE 225 Chemical Proc Systems ^{1b}	3
MA 242 Calculus III ^{1b}	4	MA 341 Applied Differential Eq ^{1b}	3
PY 208 Physics Engr & Sc II	3	EC 205 Econ (or EC 201 or ARE 201)*	<u>3</u>
PY 209 Physics Engr & Sc II Lab	<u>1</u>		17
	17		

Fall Semester	Credit	Spring Semester	Credit
BCH 451 Intro Biochemistry	4	BEC 426 Industrial Micro & Bioman Lab	2
BEC 363 Found Recomb Micro for Biom	2	BEC 330 Prin & Applications of Biosep	2
BEC 463 Ferm of Recomb Microorg	2	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I ¹	3	CHE 316 Thermo of Chem & Phase Eq	3
CHE 315 Chem Process Thermo ¹	3	Free Elective	3
GEP Requirement*	<u>3</u>	GEP Requirement*	<u>3</u>
	17		16

Fall Semester	Credit	Spring Semester	Credit
BEC 536 Intro. to Downstream Process Development ³	2	CHE 551 Biochemical Engineering OR	
BEC 580 Large Scale Fermentation ³	2	BEC 575 Global Regulatory Affairs ³	3
OR		CHE 435 Proc System Analy & Control	3
BEC 585 Large Scale Recov & Purif	2	CHE 451 CHE Design II	3
CHE 395 Professional Dev Seminar	1	Bioethics Course (GEP IP Req*) ⁴	3
CHE 447 Bioreactor Engineering	3	GEP Requirement*	2
CHE 450 CHE Design I	3	BEC 620 Prep. For Industry Internship ⁶	<u>2-3</u>
GEP Requirement*	<u>3</u>		16-17
	14		

Fall Semester	Credit	Spring Semester	Credit
BEC 590 Industry Practicum	3	BEC 575 Global Regulatory Affairs OR	
BEC 580 Large Scale Fermentation	2	CHE 551 Biochemical Engineering	3
OR BEC 585 Large Scale Recov & Purif	2	BEC/CHE 577 Adv. Biomanufacturing & Biocatalysis	3
BEC 540 Industrial Expression Systems OR BIT 510 Molecular Biology	3-4	BEC 515 Biopharmaceutical Product Characterization OR BEC/CHE 588 Cell Culture Engineering	2
BEC 621 Comm. in Biomanufact. ⁶	2	ST 516 Statistics for Engineers II OR	
ST 515 Statistics for Engineers I	<u>3</u>	BEC, BIT OR CHE 5xx Elective	<u>2-3</u>
	13-14		10-11

Minimum Credit Hours Required for Graduation: 151

Major/Program requirements and footnotes:

^{1a} Must be completed with grade of (C) or higher.

^{1b} Must be completed with grade of (C-) or higher.

² The Biomanufacturing elective course must be selected from the following list: BEC/CHE 462, BEC 580, BEC/BME 483, BEC 585, BEC 497, BIT 466, BEC 595. NOTE: Courses selected from the choice of either BEC 436, BEC 440, BEC 441, BEC 480 **OR** BEC 485, BIT 410 cannot be used to satisfy the ABM requirement.

³ BEC courses that must be taken for graduate credit: BEC 536, BEC 540, BEC 541, BEC 580 **OR** BEC 585, BEC 575

⁴ The bioethics course must be selected from: IDS 201, 303; STS 302, 304; STS(PHI) 325

⁵ Students must have a minimum overall GPA of 3.0 through the end of the junior year and must maintain this GPA through the senior year to be admitted into the program. Students who wish to complete the Accelerated BS/MS CHE BIOM degree program must apply for candidacy to the MS degree during the fall semester of the senior year. The admissions process includes submitting the following information to the Biomanufacturing Graduate Administrator, Mr. Chris Smith:

- (1) Completed copy of the signed graduate application form
- (2) NC Residency Form if you wish to claim NC residency for tuition purposes
- (3) Non-Refundable application fee in form of a check or money order
- (4) Three letters of recommendation and a personal statement outlining your career goals
- (5) Official transcript sent directly from every college and graduate school attended
- (8) Graduate Record Examination (**GRE**) scores

Students must receive a grade of B (3.0/4.0) or better in the double counted graduate level BEC or CHE courses. Courses with a grade of B- or below cannot be double counted between the two degrees. No more than twelve (12) hours of graduate work may be counted towards the requirements of both degrees. Students must complete the Master's degree within 12 months from the completion of the baccalaureate degree. If the Master's program is not completed within these time limits, none of the courses can be double counted. Note that the B.S. Degree must be completed in order to get the dual BS/MS (students cannot double major in something else and then skip to the MS CHE). Recipients of the MS BIOM degree must earn a minimum semester GPA of 3.0 during the final two semesters, including no more than one C grade in a 5xx level CHE or BEC course.

⁶A paid biomanufacturing or biotechnology industry internship is required in the summer between year 4 and year 5. Credit for this internship will be awarded by enrolling in BEC 621 in year 5.

***General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/>.

PHYSICAL EDUCATION - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

HUMANITIES - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

SOCIAL SCIENCES - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

ADDITIONAL BREADTH - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

INTERDISCIPLINARY PERSPECTIVES - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

Co-requisites:

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.