

Routing for On-Campus Approval of Degree Program Actions

Type of Action: Enter "X" for Action Type(s) and list Title and Prefix(s) as indicated

<input checked="" type="checkbox"/> New ABM Degree Program	Proposed Program Title <u>BS Chemical Engineering/MS Biomanufacturing</u>
<input type="checkbox"/> New Certificate Program	Proposed Certificate Program Title _____
<input type="checkbox"/> New Minor Program	Proposed Minor Program Title _____
<input type="checkbox"/> Change in Degree Program Title	Current Degree Program Title _____
<input type="checkbox"/> Change in Certificate Program Title	Current Certificate Program Title _____
	Proposed Certificate Program Title _____
<input type="checkbox"/> Change in Minor Program Title	Current Minor Program Title _____
	Proposed Minor Program Title _____
<input type="checkbox"/> Change in Course Prefix	Current Course Prefix _____ Proposed Course Prefix _____
<input type="checkbox"/> Program Discontinuation	

Proposed Effective Date 8-1-18 Program Contact: LISA Bullard

Proposed CIP Code (see <https://nces.ed.gov/ipeds/cipcode/default.aspx?y=55>): _____

Routing of Action: Indicate date when the following occurs

Completed Request to Plan and 1-page Concept Paper

_____ Council of Dean's- Approval to Plan

Completed Proposal

BSF Department Heads endorse*

2.21.18 College Curriculum Committee (graduate) recommends*

2.21.18 College Dean endorses*

Proposal moves to Undergraduate or Graduate office for routing

_____ Recommended by Vice Provost, DELTA, if applies*

_____ Substantive Change Review Team (SCRT) informed

_____ If SACS notification is required, SCRT prepares letter for Chancellor to send to SACS

_____ University Courses & Curriculum Committee **or** Administrative Board of the Graduate School recommends

_____ Associate Deans Council **or** Graduate Operations Council informed

_____ Dean (Graduate School or DASA) approves*

Proposal move to the Executive Vice Chancellor Provost's office for routing

_____ Vice-Provosts informed

_____ Deans' Council recommends*

_____ Executive Vice Chancellor and Provost approves*

_____ Chancellor's Executive Officer's (EOM) recommend

_____ University Council informed

_____ Board of Trustees subcommittees recommend

_____ Chancellor approves*

_____ Accreditation Liaison notifies SACS, if applicable

_____ Submitted to UNC-General Administration by Provost's Office

* Signature is required on the signature page for the action

Proposal for ABM degree: BS Chemical Engineering/MS Biomanufacturing
North Carolina State University

This request has been reviewed and approved by the appropriate campus committees and authorities.

Endorsed By:

Peter Fedkin, Head Peter Fedkin 2/12/18
Head, Department/Director of Undergraduate Program (Printed Name and Signature) Date

MICHAEL FLICKINGER, DGP Michael Flickinger 2/15/18
Head, Department/Director of Graduate Program (Printed Name and Signature) Date

Recommended By:

Douglas J. Rung 2-21-18
Chair, College Graduate Studies Committee (Printed Name and Signature) Date

Endorsed By:

Douglas J. Rung 2-21-18
College Dean (Printed Name and Signature) Date

Recommended By:

Vice Provost, DELTA (if DE degree) (Printed Name and Signature) Date

Approved By:

Dean of the Graduate School (Printed Name and Signature) Date

Recommended By:

Dean's Council (Printed Name and Signature) Date

Approved By:

Executive Vice Chancellor and Provost (Printed Name and Signature) Date

Approved By:

Chancellor (Printed Name and Signature)

NC STATE UNIVERSITY

Campus Box 7905
2012 Engineering Building I
Raleigh, NC 27695-7905
lisa_bullard@ncsu.edu
919-515-7455

January 28, 2018

From: Lisa G. Bullard
Director of Undergraduate Studies
Department of Chemical and Biomolecular Engineering

Michael C. Flickinger
BTEC Director for Academic Programs
Biomanufacturing Training and Education Center

Subject: Accelerated BS Chemical Engineering/MR Biomanufacturing degree

By means of this memorandum and the attached documents, the Department of Chemical and Biomolecular Engineering and the Biomanufacturing Training and Education Center propose to establish an Accelerated BS Chemical Engineering/MR Biomanufacturing degree program.

Proposal for ABM degree: BS Chemical Engineering/MR Biomanufacturing

Objectives:

- To attract undergraduate CHE students completing the biomanufacturing concentration to complete the MR Biomanufacturing degree with one additional year
- To provide well-qualified engineering graduates with biochemical engineering, engineering statistics, biomanufacturing, and GMP training at an accelerated pace to the biomanufacturing industry in North Carolina

Mechanism:

Graduate level elective courses in the CHE-Biomanufacturing curriculum may be “double counted” to satisfy the requirements of the BS CHE degree and the MR Biomanufacturing degree.

Eligibility:

Students must have a minimum overall GPA of 3.5 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/MR CHE BIOM degree program can apply for candidacy to the MR degree once they have completed a minimum of 75 credits or a maximum of 96 credits. Typically this will occur during the spring semester of the junior year. The admissions process includes submitting the following information to the Biomanufacturing Graduate Administrator:

- (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 attended
- (8) Graduate Record Examination (**GRE**) scores

Requirements: 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. The ABM plan of work must be submitted to the graduate administrator in BTEC prior to the senior year. Students must complete the MR degree within 12 months from the completion of the baccalaureate degree. If the MR 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/MR (students cannot double major in something else and then skip to the MR CHE). Recipients of the MR 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. A paid biomanufacturing or biotechnology industry internship is required in the summer between year 4 and year 5.

Modification of degree requirements:

- For the BS CHE degree: Students will complete BEC 536 and either BEC 580 or BEC 585 in the fall of the senior year. They will complete either CHE 551 or BEC 475, and BEC 620 in the spring of their senior year.
- For the MR BIOM degree: Students will complete 1 semester of BEC 590 in their 5th year. They will be required to complete a paid industry internship during the summer between their 4th and 5th year and receive credit for this experience by completing BEC 621 in their 5th year. Students will complete BEC 540 or BIT 510, CHE 551 and ST 515

and have the option of completing ST 516 or a CHE 5xx elective. BEC 540 or BIT 510, CHE 551, STS 515 and STS 516 are not required for the MR BIOM degree.

Proposed Effective Date: 8/1/2018

Accelerated Master's Degree in Biomanufacturing
(BS CHE Biomanufacturing Concentration/MR 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		CH 224 (or 228) Organic Chem II Lab	1
CHE 205 Chemical Proc Prin ^{1b}	1	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	4	EC 205 Econ (or EC 201 or ARE 201)*	<u>3</u>
PY 209 Physics Engr & Sc II Lab	3		17
	<u>1</u>		
	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		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		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 3.5 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/MR CHE BIOM degree program can apply for candidacy to the MR degree once they have completed a minimum of 75 credits or a maximum of 96 credits. Typically this will occur during the spring semester of the junior year. The admissions process includes submitting the following information to the Biomanufacturing Graduate Administrator:

- (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 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. The ABM plan of work must be submitted to the graduate administrator in BTEC prior to the senior year. Students must complete the MR degree within 12 months from the completion of the baccalaureate degree. If the MR 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/MR (students cannot double major in something else and then skip to the MR CHE). Recipients of the MR 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. A paid biomanufacturing or biotechnology industry internship is required in the summer between year 4 and year 5.

⁶ A 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.