



New Program Proposal: Graduate Degree Program

Form 2B

Version 2016-10-13

This form should be used to seek SUNY’s approval and New York State Education Department’s (SED) registration of a proposed new academic program leading to master’s or doctoral degree. Approval and registration are both required before a proposed program can be promoted or advertised, or can enroll students. The campus Chief Executive or Chief Academic Officer should send a signed cover letter and this completed form (unless a different form applies¹), which should include appended items that may be required for Sections 1 through 6, 9 and 10 and MPA-1 of this form, to the SUNY Provost at program.review@suny.edu. The completed form and appended items should be sent as a single, continuously paginated document.² If Sections 7 and 8 of this form apply, External Evaluation Reports and a single Institutional Response should also be sent, but in a separate electronic document. Guidance on academic program planning is available [here](#).

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NOTE: Please update this Table of Contents automatically after the form has been completed. To do this, put the cursor anywhere over the Table of Contents, right click, and, on the pop-up menus, select “Update Field” and then “Update Page Numbers Only.” The last item in the Table of Contents is the List of Appended and/or Accompanying Items, but the actual appended items should continue the pagination.

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¹Use a different form if the proposed new program will lead to a graduate degree or any credit-bearing certificate; be a combination of existing registered programs (i.e. for a multi-award or multi-institution program); be a breakout of a registered track or option in an existing registered program; or **lead to certification as a classroom teacher, school or district leader, or pupil personnel services professional** (e.g., school counselor).

²This email address limits attachments to 25 MB. If a file with the proposal and appended materials exceeds that limit, it should be emailed in parts.

Section 1. General Information	
a) Institutional Information	Date of Proposal: 2/12/2020
	Institution's 6-digit SED Code : 211000
	Institution's Name: Binghamton University
	Address: 4400 Vestal Pkwy East, Binghamton, NY 13902
	Dept of Labor/ Regent's Region : Southern Tier
b) Program Locations	List each campus where the entire program will be offered (with each institutional or branch campus 6-digit SED Code): Binghamton University, 211000
	List the name and address of off-campus locations (i.e., extension sites or extension centers) where courses will offered, or check here [X] if not applicable :
c) Proposed Program Information	Program Title: Biochemistry and Chemical Biology
	Award(s) (e.g., M.A., Ph.D.): M.A., M.S., Ph.D.
	Number of Required Credits: Minimum [(30 MA, 34 MS, 60 PhD] If tracks or options, largest minimum []
	Proposed HEGIS Code : [0414.00]
	Proposed 6-digit CIP 2010 Code : [26.0202]
	If the program will be accredited, list the accrediting agency and expected date of accreditation:
	If applicable, list the SED professional licensure title(s) ³ to which the program leads:
d) Campus Contact	Name and title: Andover Tarhule, Dean of the Graduate School, Binghamton University
	Telephone: (607) 777-2070 E-mail: atarhule@binghamton.edu
e) Chief Executive or Chief Academic Officer Approval	Signature affirms that the proposal has met all applicable campus administrative and shared governance procedures for consultation, and the institution's commitment to support the proposed program. E-signatures are acceptable.
	Name and title: Donald Nieman, Executive Vice President and Provost
	Signature and date:
If the program will be registered jointly⁴ with one or more other institutions, provide the following information for <u>each</u> institution:	
Partner institution's name and 6-digit SED Code :	
Name, title, and signature of partner institution's CEO (or append a signed letter indicating approval of this proposal):	

³ If the proposed program leads to a professional license, a [specialized form for the specific profession](#) may need to accompany this proposal.

⁴ If the partner institution is non-degree-granting, see SED's [CEO Memo 94-04](#).

Attestation and Assurances

On behalf of the institution, I hereby attest to the following:

That all educational activities offered as part of this proposed curriculum are aligned with the institutions' goals and objectives and meet all statutory and regulatory requirements, including but not limited to Parts 50, 52, 53 and 54 of the Rules of the Board of Regents and the following specific requirements:

That credit for study in the proposed program will be granted consistent with the requirements in §50.1(o).

That, consistent with §52.1(b)(3), a reviewing system has been devised to estimate the success of students and faculty in achieving the goals and objectives of the program, including the use of data to inform program improvements.⁵

That, consistent with §52.2(a), the institution possesses the financial resources necessary to accomplish its mission and the purposes of each registered program, provides classrooms and other necessary facilities and equipment as described in §52.2(a)(2) and (3), sufficient for the programs dependent on their use, and provides libraries and library resources and maintains collections sufficient to support the institution and each registered curriculum as provided in §52.2(a)(4), including for the program proposed in this application.

That, consistent with 52.2(b), the information provided in this application demonstrates that the institution is in compliance with the requirements of §52.2(b), relating to faculty.

That all curriculum and courses are offered and all credits are awarded, consistent with the requirements of §52.2(c).

That admissions decisions are made consistent with the requirements of §52.2(d)(1) and (2) of the Regulations of the Commissioner of Education.

That, consistent with §52.2(e) of the Regulations of the Commissioner of Education: overall educational policy and its implementation are the responsibility of the institution's faculty and academic officers, that the institution establishes, publishes and enforces explicit policies as required by §52.2(e)(3), that academic policies applicable to each course as required by §52.2(e)(4), including learning objectives and methods of assessing student achievement, are made explicit by the instructor at the beginning of each term; that the institution provides academic advice to students as required by §52.2(e)(5), that the institution maintains and provides student records as required by §52.2(e)(6).

That, consistent with §52.2(f)(2) of the Regulations of the Commissioner of Education, the institution provides adequate academic support services and that all educational activities offered as part of a registered curriculum meet the requirements established by state, the Rules of the Board of Regents and Part 52 of the Commissioner's regulations.

CHIEF ADMINISTRATIVE or ACADEMIC OFFICER/ PROVOST	
Signature	Date
Type or print the name and title of signatory	Phone Number
Donald G. Nieman, Executive Vice President for Academic Affairs and Provost	(607) 777-2141

⁵ The NY State Education Department reserves the right to request this data at any time and to use such data as part of its evaluation of future program registration applications submitted by the institution.

Section 2. Program Information⁷

2.1. Program Format

Check all SED-defined [formats, mode and other program features](#) that apply to the **entire program**.

a) **Format(s):** Day Evening Weekend Evening/Weekend Not Full-Time

b) **Modes:** Standard Independent Study External Accelerated Distance Education

NOTE: If the program is designed to enable students to complete 50% or more of the course requirements through distance education, check Distance Education, see Section 10, and append a [Distance Education Format Proposal](#).

c) **Other:** Bilingual Language Other Than English Upper Division Cooperative 4.5 year 5 year

2.2. Related Degree Program

NOTE: This section is not applicable to a program leading to a graduate degree.

2.3. Program Description, Purposes and Planning

a) What is the description of the program as it will appear in the institution's catalog?

The Biochemistry and Chemical Biology graduate program will prepare students for careers at the interface between the chemical and biological sciences. As a highly interdisciplinary program, it will provide opportunities for education in the molecular aspects of life, for example how biomolecules operate, fold, interact, and direct cellular function. Students will integrate cutting edge laboratory research with classroom work to generate new knowledge about biochemical and chemical biology mechanisms and pathways, and the implications of these mechanisms for human disease. Graduates from the program will work as researchers in academia, educators, in the pharmaceutical and biotech industry, as well as in the public sector.

b) What are the program's educational and, if appropriate, career objectives, and the program's primary student learning outcomes (SLOs)? *NOTE: SLOs are defined by the Middle States Commission on Higher Education in the [Characteristics of Excellence in Higher Education](#) (2006) as "clearly articulated written statements, expressed in observable terms, of key learning outcomes: the knowledge, skills and competencies that students are expected to exhibit upon completion of the program."*

The *major goal* of the program is to prepare well-educated and technically skilled graduates who will be able to find employment using their interdisciplinary education at the interface of the chemical and biological sciences, contributing to their field of study, the profession, and society as a whole. According to this goal, students not only have to become experts in their discipline, by generating new knowledge through performing cutting edge and novel research in the laboratory, they will also learn professional skills necessary to succeed in a competitive job market, for example in scientific presentation, working on a team, grant writing, and leadership skills.

This major goal is subdivided into four aims:

1) Broad Knowledge

Demonstrate broad knowledge in the area of biochemical and chemical biology sciences pertinent to the student's research interests.

2) In-Depth Knowledge in Focused Area

Demonstrate in-depth and advanced knowledge and become an expert in a specialized area of biochemical research.

3) Original Research Project

Demonstrate ability to design, conduct and disseminate results of an original research project.

4) Professional Skills

Demonstrate professional skills required to work in biochemical/pharmaceutical industry, academia and government.

The ten primary student learning outcomes (SLOs) are derived from these four major aims. These SLOs are assessable (see below, section 2.7), and are shown in the following list:

1. Broad knowledge and ability to understand biochemical information: Students are expected to master key foundational knowledge in biochemistry and chemical biology, and to apply this knowledge to further learning and research.

2. Writing, presentation and communication of biochemical science: Students will learn how to communicate knowledge and results from their graduate studies. Particular emphasis will be placed on writing, oral communication, and presentations in biochemistry and chemical biology.

3. Specific knowledge of a specialized field of biochemistry: Students will develop deep working knowledge of a specific area of biochemistry and chemical biology, as it pertains to a research project or thesis.

4. Critical evaluation of primary literature: Utilize and evaluate information from literature resources to integrate and improve research outcomes.

5. Identify problem, develop hypothesis and design experiments: Students will learn to identify a biochemical problem, develop general and specific hypotheses and design experiments that quantitatively evaluate these hypotheses.

6. Original published contributions to biochemical and life sciences: Expectations are to publish original work in peer-reviewed scientific journals in the area of biochemistry and chemical biology, or in the life sciences in general (only for Ph.D. track, not applicable to M.S./M.A. tracks).

7. Original research project: Students will design and execute research towards a project with the aim to publish in peer-reviewed journals, and the eventual writing of a thesis that will be orally defended (only for Ph.D. and M.S. tracks, for the M.A. track, the students will give a brief public presentation of their project as degree requirement).

8. Students will become skillful and professional teachers: Participate in classroom and laboratory education as a teaching assistant or instructor of record, to develop skills as teachers of biochemical sciences.

9. Leadership skills: Students will learn to advise students in the laboratory as well as in the classroom. The expectation is to take on increasing leadership with increasing seniority.

10. Safety, ethics, honesty, and integrity: Students will learn to conduct biochemical research with safety, strong ethics, honesty, and integrity.

c) How does the program relate to the institution's and SUNY's mission and strategic goals and priorities?

What is the program's importance to the institution, and its relationship to existing and/or projected programs and its expected impact on them? As applicable, how does the program reflect diversity and/or international perspectives? For doctoral programs, what is this program's potential to achieve national and/or international prominence and distinction?

In August of 2017, Binghamton University released the latest strategic plan, "The Roadmap to Premier". The roadmap includes four university initiatives (UIs), two of which are centered around the health sciences, *Developing a College of Nursing and Health Sciences*, and creating a *Health Sciences Core Facilities Support combined with the Brain and Body Imaging Center*. Both of those initiatives would directly be impacted by the proposed graduate programs in Biochemistry and Chemical Biology, which would generate collaborative opportunities with the planned college of health science, as well as provide users to add to the critical mass of students and faculty who benefit from the health sciences core. In fact, several current Binghamton faculty who are members of the existing Biochemistry undergraduate program, are intimately involved in the planning of the health sciences core facility. It is expected that graduate students who are admitted through the proposed Biochemistry and Chemical Biology graduate program, in synergy with the core facilities, will strengthen the research programs of the affiliated faculty, resulting in an increased ability to compete for federal and other funding sources.

Second, the proposed graduate program will directly impact the existing Trans-disciplinary Area of Excellence (TAE) in Health Science. The Biochemistry and Chemical Biology graduate program will by nature be crossing disciplines, ranging from Biology to the Physical Sciences and Bioengineering, thus creating new opportunities for collaboration

in Health Sciences not only within Harpur College, but also with the Watson School of Engineering, and the new Pharmacy School.

Finally, a third part of the roadmap focuses on a Data Science Initiative. As research at the interface between biology and chemistry becomes more quantitative, collection and evaluation of large data sets will be more common in the future. In fact, several members of the Chemistry and Biological Sciences Departments, all potential members of the proposed Biochemistry and Chemical Biology program, work on analysis of large data sets for example in genetics, or use computational tools for studying biochemical processes. Availability of computational resources will be increasingly critical in these fields. The Biochemistry and Chemical Biology graduate program would add an additional incentive for the university to expand in the data science field, making investigators more competitive in their ability to tackle large data science projects and increasing likelihood of attaining funding.

The program, which will be administered in a collaboration between the Chemistry and Biological Sciences Departments, with input of other departments on the BU campus, is expected to continue existing, or increase future participation of a diverse population of faculty and graduate students in these departments. For example, the faculty body in the Chemistry Department consists of members from eight different nationalities, both male and female, and of three different ethnicities. While female faculty members represent only 22.3% of the faculty body, strides are being made to address this gender imbalance. Three of the four female faculty members in the Chemistry Department were hired within the last five years, all of them will contribute to the proposed program. The Biological Sciences Department is also highly diverse. Out of the total of 29 faculty members 42% are female, from four countries and three ethnicities.

The existing graduate student body in both Chemistry and Biological Sciences graduate programs is also highly diverse, with traditionally about 45-55% of students being international. The domestic student pool includes minority students, both African American and Hispanic, several of whom are supported by the Clifford D. Clark diversity fellowship for graduate students. It is planned that the new Biochemistry and Chemical Biology graduate program will continue this tradition of both Chemistry and Biology programs of inclusion of a diverse set of students and faculty members.

Of special note is the Wandiga-Hull fellowship program, which was established between the Chemistry Departments of Binghamton University and the University of Nairobi in Kenya, Africa. Through this fellowship, our existing graduate program is committed to accept at least one of the top three Chemistry graduates from the University of Nairobi into the program each year. Currently, the program has nine students from Kenya, including five Wandiga-Hull fellows. The proposed Biochemistry and Chemical Biology graduate program plans to draw students from this Kenyan pool of applicants, having established direct contacts through former students (now faculty members) with the University of Nairobi, Kenyatta University, and Dedan Kimathi University of Technology.

- d)** How were faculty involved in the program's design? Describe input by external partners, if any (e.g., employers and institutions offering further education?)

The proposal of a Biochemistry and Chemical Biology graduate program originates from a long-standing effort at Binghamton University to expand the existing undergraduate Biochemistry program to graduate education. This effort started in 2013 by the establishment of a Biochemistry task force by Provost Nieman, chaired by Dr. Christof Grewer from the Chemistry Department. The program was designed by a group of faculty members from Chemistry, including department chair Dr. Eriks Rozners, in close collaboration with the faculty from the Biological Sciences Department, in particular current chair Dr. Karin Sauer.

Both the Departments of Chemistry and Biological Sciences have continued to expand in numbers of faculty members with research expertise at the interface of the chemical and biological sciences. For example, following its strategic plan, the Chemistry Department has hired eight faculty members at the interface between Chemistry and Biology over the past 10 years. These faculty members perform research in the area of the proposed program and could accept graduate students from the program into their laboratory. Nine of these faculty members are currently funded by the NIH and/or NSF, and one is holding PRF funding (see faculty table, section 4). The Department of Biological Sciences has likewise hired four faculty members at the interface between Chemistry and Biology in the

last 7 years. Three Biological Sciences faculty members are currently funded by the NIH/NSF (see faculty table, section 4). They have resources to support independent research by Master's/Ph.D. track students who are expected to enroll in the program. The expertise of these faculty members covers a broad range, from structural biology to nucleic acid chemistry, giving graduate students exposure to a large number of opportunities in Biochemistry and Chemical Biology research. All of these faculty members have published in journals that are relevant to the proposed program.

Additional expertise not covered by faculty members in the Chemistry Department is provided by the Biological Sciences Department, which has strengths in environmental genetics (EvoS program), microbial communities (biofilm group), mitochondrial genetics, and diabetes research, as potential contributors to the proposed graduate program (see faculty table, section 4). In addition, contributions from other schools at BU are expected (School of Pharmacy, Watson School of Engineering).

The outline of the proposed program received input from many of those faculty members. Details of the program were extensively discussed in the graduate program committee (GPC) and the graduate admissions committee (GAC) of the Chemistry Department (all discussions archived in meeting minutes), as well as the faculty meetings of both, Chemistry and Biological Sciences. All Chemistry and Biological Sciences subcommittees and faculty have voted on the program proposal and have approved it.

Binghamton faculty performing research in the Biochemistry/Chemical Biology area have a strong history of collaboration with external partners, including collaboratively-funded projects. Students in the program will strongly benefit from these collaborations, including those with international partners. Faculty members contributing to the proposal have discussed the planned program with these collaborators, as well as visiting speakers in the Chemistry Department colloquium series. In addition, input was sought from the external reviewers who conducted the last departmental review.

- e) How did input, if any, from external partners (e.g., educational institutions and employers) or standards influence the program's design? If the program is designed to meet specialized accreditation or other external standards, such as the educational requirements in [Commissioner's Regulations for the profession](#), append a side-by-side chart to show how the program's components meet those external standards. If SED's Office of the Professions requires a [specialized form](#) for the profession to which the proposed program leads, append a completed form at the end of this document.

Biochemistry and/or Chemical Biology graduate programs generally do not require accreditation from professional societies. For example, for the areas of Chemistry and Biochemistry, the American Chemical Society (ACS) is the world's largest scientific society. While the ACS provides certifications for undergraduate programs, no such certifications or accreditations exist for graduate programs. This is similar for the American Society for Biochemistry and Molecular Biology (ASBMB), another scientific society in the proposed program field of study.

To get external input on the proposed program, the organizing faculty relied mainly on two mechanisms:

- 1) Extensive review of similar programs at other institutions, preferably institutions in the North East of the US and of similar ranking. For example, the graduate programs for Biological and Biomedical Sciences, and Chemistry and Biological Chemistry at Cornell University were reviewed. For guidance from SUNY schools, the graduate program in Biochemistry and Structural Biology from Stony Brook University was studied. Information from these programs helped the organizing faculty members with curriculum development, as well as course requirements.

- 2) As already discussed in the previous section, d), input was sought from collaborators, as well as colleagues visiting Binghamton University as speakers in the Chemistry colloquium, who are members of similar graduate programs.

- f) Enter anticipated enrollments for Years 1 through 5 in the table below. How were they determined, and what assumptions were used? What contingencies exist if anticipated enrollments are not achieved?

We project that the new graduate program will begin in the Fall of 2020. The target for admissions in the first year is 2-3 Ph.D. track students and 4-5 Master's students. At a constant admissions rate, we expect to have 18-27 students in the program at year five, about half of those will be on the Ph.D. track. Traditionally, many of the domestic students in the existing chemistry graduate program are in state. We expect this trend to continue in the admissions to the new program. 40% of the incoming students are expected to be international.

These numbers are based on our experience with current chemistry graduate students, who specialize in the existing biological chemistry track of the program. It is expected that most of these biological chemistry track students (who graduate with a degree in chemistry) will enter through the proposed Biochemistry and Chemical Biology program in the future. If enrollments are not achieved, the program will grow more slowly than predicted. This is not a problem because faculty members with research in Biochemistry and Chemical Biology can still recruit research students through the existing biology and chemistry graduate programs, as is current practice.

Year	Anticipated Headcount Enrollment			Estimated FTE
	Full-time	Part-time	Total	
1	6	0	6	6
2	12	0	12	12
3	18	0	18	18
4	22	0	22	22
5	24	0	24	24

- g) Outline all curricular requirements for the proposed program, including prerequisite, core, specialization (track, concentration), internship, capstone, and any other relevant component requirements, but do not list each General Education course.

The course offerings for the Biochemistry and Chemical Biology graduate program are listed below.

Course Title	Credits
BIOL 502, BIOCHEMISTRY: METABOLIC ASPECTS	4
CHEM 534, BIO-ORGANIC CHEMISTRY	4
BCHM 507, ADVANCED BIOCHEMISTRY, <u>REQUIRED</u>	4
BCHM 508, METHODS IN BIOCHEM. CHEM. BIOL., <u>REQUIRED</u>	4
CHEM 583L, CHEMICAL BIOLOGY	4
CHEM 583M, ENZYMES: STRUCTURE AND MECHANISM	4
CHEM 583P, PROTEIN BIOCHEMISTRY	4
CHEM 583S, FLUORESCENCE	4
CHEM 586S, NMR SPECTROSCOPY	4
CHEM 585K, CHEMICAL KINETICS AND THE LIFE SCIENCES	4

Course Title	Credits
BIOL 521, IMMUNOLOGY	4
CHEM 583D, CHEMISTRY IN DRUG DISCOVERY	4
BIOL 558, BIOSTATISTICS	4
BIOL 523, CANCER BIOLOGY	4
CHEM 585C, COMPUTATIONAL CHEMISTRY	4
CHEM 543, MOLECULAR PHOTOCHEMISTRY	4
CHEM 593, FRONTIERS IN CHEM. AND BIOCHEM., <u>REQUIRED</u>	1
CHEM 592, GRADUATE SEMINAR, <u>REQUIRED</u>	2
BIOL 503, MOLECULAR BIOLOGY LABORATORY	4
BIOL 504, BIOCHEMISTRY LABORATORY	4

BIOL 505, GENOMICS AND PROTEOMICS	4	CHEM 584B, BIO-INORGANIC CHEMISTRY (NEW COURSE)	4
BIOL 501, MOLECULAR GENETICS	4	CHEM 542, PHYSICAL INORGANIC CHEMISTRY	4
BIOL 513, CELL AND MOLECULAR BIOLOGY I	4	CHEM 582C, CHEMISTRY AND THE ENVIRONMENT	4
BIOL 514, CELL AND MOLECULAR BIOLOGY II	4		
CHEM532, ORGANIC SYNTHESIS	4		
CHEM 583C, MODERN CATALYTIC REACTIONS	4		
Total required credits: 60 (Ph.D.), 34 (M.S.), 30 (M.A.)			
Independent study (research) courses and thesis research, for example CHEM597-699 are not listed here.			
Note: All CHEM and BIOL graduate courses in this table will be cross-listed with the prefix BCHM			

Ph.D. track.

Students will have a choice to take four 4-credit courses from the list below. Courses 5 and 6, filling the 24 credit full course requirements, are two capstone courses, Advanced Biochemistry and Contemporary Methods in Biochemistry and Chemical Biology. These are new courses. The four elective courses should align with the research direction the student chooses, and are usually recommended and approved by the graduate program chair and/or the research adviser. Only four courses are requirements. These courses are the Advanced Biochemistry course (course number TBD), Contemporary Methods in Biochemistry and Chemical Biology (course number TBD), the Colloquium (CHEM 593), which has to be taken for two semesters with one credit each, and the Graduate Seminar (CHEM 592) for two credits, usually taken in the spring semester of the first year. The courses do not have pre-requisites. However, weak students, as identified by placement exams, will be required to take remedial courses to make up for deficiencies. Training in topics such as career development, scientific writing and communications, grant writing, laboratory safety and research ethics are provided through university-wide resources (for example responsible conduct of research training modules) and in the graduate seminar, which is a required course.

Additional training in ethics, responsible conduct of research, etc is outlined in the following three paragraphs:

Binghamton University provides training for responsible conduct in research (RCR), through face-to-face, as well as online training. The procedures for training are detailed on the Binghamton University research compliance website.

Participation in annual online training through the CITI system, including RCR and EH&S safety training will be required for all students entering the program. In addition, training will be provided in animal use and human subjects, should the individual research projects involve these subjects.

Furthermore, training in RCR will be incorporated into the graduate seminar CHEM 592, which students take in their second semester at Binghamton University.

Sample Curriculum

Biochemistry and Chemical Biology, Ph.D. track

Fall semester, first year Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr Methods in Biochem. Chemical Biology, (new course), required 4cr Colloquium, required (CHEM 593) 1cr Independent Study 3cr	Spring semester, first year Advanced Molecular Biology (BIOL513) 4cr Advanced Cell Biology (BIOL 514) 4cr Graduate Seminar, required (CHEM 592) 2cr Colloquium, required (CHEM 593) 1cr Independent Study 1cr
Fall semester, second year Special Topics Course (elective) 4cr Special Topics Course (elective) 4cr Independent Study 1cr	Spring semester, second year Thesis Research 9cr
Fall semester, third year Thesis Research 9cr	Spring semester, third year Thesis Research 9cr
Fall semester, fourth year Thesis Research 1cr	Spring semester, fourth year Thesis Research 1cr

The following degree requirements have to be met:

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Attaining course complete (CC) status, i.e. completion of six 4-credit courses, graduate seminar and two semesters of colloquium. CC status should be attained latest after the end of the 2nd year.
- 3) Passing of the literature review exam.
- 4) Passing of the comprehensive oral exam and submission of the prospectus.
- 5) Attaining all but dissertation (ABD) status.
- 6) Passing of a progress report exam.
- 7) Completion of original research in a specialized area of Biochemistry and Chemical Biology.
- 8) Submission of a written M.S. thesis and an oral defense of the thesis. The thesis defense committee consists of at least four faculty members, with at least one tenured Biochemistry and Biological Chemistry program faculty member who is not the research advisor. The committee chair will be a tenured faculty member who is not the research advisor. In addition, an external examiner is required, according to graduate school regulations.

Master's tracks

The Master's program consists of two tracks that will lead to M.S. and M.A. degrees. Traditionally, the M.A. degree is the course-only based, non-thesis option, whereas the M.S. degree requires the completion and defense of a Master's thesis. As non-thesis based M.S. tracks become more common in the field, such an option is evaluated at the current time, but will not be implemented immediately at the start of the new program.

The M.S. program consists of four 4-credit graduate courses, two of which are required (Advanced Biochemistry and Contemporary Methods in Biochemistry and Chemical Biology). The remaining two 4-credit courses can be chosen as electives from the course list provided in the table in section 2.3 g). The other required courses consist of the Graduate Seminar (2 credits) and two semesters of colloquium attendance (1 credit each). The overall M.S. track will require a minimum of 34 credits, with a minimum of 24 credits to fulfill the residency requirement, as to graduate school rules. The final 10 credits will be contributed by independent study and thesis research. A proposed sample sequence is shown below.

Additional training in ethics, responsible conduct of research, etc is outlined in the following three paragraphs:

Binghamton University provides training for responsible conduct in research (RCR), through face-to-face, as well as online training. The procedures for training are detailed on the Binghamton University research compliance website.

Participation in annual online training through the CITI system, including RCR and EH&S safety training will be required for all students entering the program. In addition, training will be provided in animal use and human subjects, should the individual research projects involve these subjects.

Furthermore, training in RCR will be incorporated into the graduate seminar CHEM 592, which students take in their second semester at Binghamton University.

Sample Curriculum

Biochemistry and Chemical Biology, M.S. track

Fall semester, first year	Spring semester, first year
Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr	Advanced Molecular Biology (BIOL513) 4cr
Methods in Biochem. Chemical Biology, (new course), required 4cr	Advanced Cell Biology (BIOL 514) 4cr
Colloquium, required (CHEM 593) 1cr	Graduate Seminar, required (CHEM 592) 2cr
Independent Study 3cr	Colloquium, required (CHEM 593) 1cr
	Independent Study 1cr
Fall semester, second year	Spring semester, second year
Independent Study 8cr	Thesis Research 1cr
Colloquium, required (CHEM 593) 1cr	

Importantly, all coursework will be completed after the first year, leaving the second year for research.

In terms of milestones, the following requirements have to be met:

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Attaining course complete (CC) status, i.e. completion of four 4-credit courses, graduate seminar and two semesters of colloquium. CC status should be attained latest after the 2nd semester.
- 3) Completion of original research in a specialized area of Biochemistry and Chemical Biology.
- 4) Submission of a written M.S. thesis and an oral defense of the thesis. The thesis defense committee consists of at least three faculty members, with at least one tenured Biochemistry and Biological Chemistry program faculty members who is not the research advisor. The committee chair will be a tenured faculty member who is not the research advisor.

The M.A. program is a non-thesis option and consists of six 4-credit graduate courses, two of which are required (Advanced Biochemistry and Contemporary Methods in Biochemistry and Chemical Biology). The remaining four 4-credit courses can be chosen as electives from the course list provided in the table in section 2.3 g). The other

required courses consist of the Graduate Seminar (2 credits) and two semesters of colloquium attendance (1 credit each). The overall M.A. track will require a minimum of 30 credits, with a minimum of 24 credits to fulfill the residency requirement, as to graduate school rules.

Sample Curriculum

Biochemistry and Chemical Biology, M.A. track

Fall semester, first year	Spring semester, first year
Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr	Advanced Molecular Biology (BIOL513) 4cr
Methods in Biochem. Chemical Biology, (new course), required 4cr	Advanced Cell Biology (BIOL 514) 4cr
Colloquium, required (CHEM 593) 1cr	Graduate Seminar, required (CHEM 592) 2cr
Independent Study 3cr	Colloquium, required (CHEM 593) 1cr
	Independent Study 1cr
Fall semester, second year	Spring semester, second year
Special Topics Course (elective) 4cr	
Special Topics Course (elective) 4cr	
Independent Study 1cr	

The following requirements have to be met:

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Completion of six 4-credit courses, graduate seminar and two semesters of colloquium.
- 3) Completion of an acceptable original research project with at least eight credits of independent study.
- 4) Public presentation of a seminar on the subject of the research project.

h) Program Impact on SUNY and New York State

- h)(1) *Need:*** What is the need for the proposed program in terms of the clientele it will serve and the educational and/or economic needs of the area and New York State? How was need determined? Why are similar programs, if any, not meeting the need?

There is strong and currently unmet need for advanced Biochemistry and Chemical Biology degrees. A graduate degree in this interdisciplinary area provides the basis for a wide variety of careers in industry and academia. The need for graduate education in Biochemistry and Chemical Biology at BU has been recognized in the past. The Chemistry Department at Binghamton University, for example, has in their strategic plan called for an expansion in the Biological Chemistry/Biochemistry discipline, which is now recognized by the American Chemical Society (ACS) as the fifth sub-discipline of Chemistry. This includes cluster hiring by the Chemistry department of faculty members with Biochemistry and Chemical Biology research interests. The Chemistry Department has long offered a Biological Chemistry track for Ph.D. students, with specialized cumulative exams. The proposed degree will formalize this program and thereby enhance visibility and recruitment of top tier graduate applicants who seek training in this emerging area of research.

The life sciences field in general continues to be a strong contributor to the US economy. Wages for R&D employees in the life sciences have grown by more than 50% over the past decade, in the background of relatively stagnant wages in the overall US economy. These statistics indicate strong demand in the industry for a qualified workforce,

most of them at the Master's and Ph.D. level. New York City (number 2), Westchester county (number 6), and the Long Island area (number 8) are among the top 10 of areas nationwide, in which new life science clusters were developed with over 2 million square feet of lab space in the New York City area alone. Since many of our undergraduate students are from these areas, advanced degrees, as offered in this proposal, may be very attractive for them to stay at Binghamton University for combined programs. The proposed graduate degrees in Biochemistry and Chemical Biology will serve these needs not only in the state, but nationwide.

STEM occupations continue to grow at an above average rate, with a growth rate of 10.5% in 2015. 24,690 of these new positions were in the life sciences. The projected growth rate for life scientists is 6.7% for 2014-2024 for projected job openings of 116,000. It is expected that this above average growth will continue to provide opportunities for graduates with life science degrees, especially at the Master and Ph.D. level.

Immediate demand was assessed from our current graduate program in Chemistry. The program receives in the range of 80 applications per year for fall admissions. About one third of these applicants state research interest in the fields of biochemistry/biological chemistry/chemical biology. These applicants would be better served receiving a degree with a title that is aligned with the actual research performed during their studies, instead of a Chemistry degree.

- h)(2) *Employment:*** For programs designed to prepare graduates for immediate employment, use the table below to list potential employers of graduates that have requested establishment of the program and state their specific number of positions needed. If letters from employers support the program, they may be **appended** at the end of this form.

After earning a doctorate, a chemical biologist can pursue postdoctoral training at research institutions, eventually leading to a career in academia at the teaching and/or research level. Biochemistry and chemical biologists are also hired in the private sector by Biotechnology companies, pharmaceutical companies, or in agriculture. While many graduates will find career opportunities in traditional laboratory and research environments, others may leave the research setting and find work in fields ranging from business and sales to consulting and law. With the recent establishment of the School of Pharmacy and Pharmaceutical Sciences, demand will increase further. In the absence of a dedicated graduate program, our ability to recruit these students will remain limited.

According to the Bureau of Federal Labor Statistics (BLS), there were 31,500 jobs in 2016 for Biochemists/Biophysicists with a Doctoral or Professional degree, with a projected growth rate of 11.5% (faster than average). Median pay in 2016 was \$82,180 per year. New York State ranks number four nationwide in employment opportunity for Biochemists, behind California, New Jersey, and Maryland. Employment opportunities are especially prevalent in the New York City/ Long Island area, from which many of our undergraduate students come.

Pre-health majors, who are not immediately successful attaining medical school admission, often try to improve their resume by enrolling in such advanced programs. A Biochemistry and Chemical Biology M.A./M.S. could fulfill a need for such advanced degrees. The Biological Sciences department has been admitting pre-health Master's students in the past with considerable success. Therefore, this model could be adapted to the Biochemistry and Chemical Biology program, increasing overall enrollment in graduate classes.

Since specific employment needs for positions related to the proposed degree are not readily available, we instead cite figures from the Bureau of Labor Statistics, see table below. From these data, it is evident that employment for Biochemists/Biophysicists with a doctoral/professional degree is projected to grow at a faster rate than jobs in the traditional Chemistry/Material Science field, thus highlighting the need for Binghamton University to provide a Biochemistry and Chemical Biology degree, in addition to the Chemistry degree.

Employer	<i>Need: Projected positions</i>	
	Ten year projected employment growth	Ten year projected numbers of new jobs
Biochemists and Biophysicists	11%	3,600
Medical Scientists	13%	16,100
Agricultural and Food Scientist	7%	3,100
Chemists and Materials Scientists	7%	6,300

Students who have in the past graduated from the Chemistry graduate program with specialization in Biological Chemistry have found diverse employment opportunities with a large number of different employers. As an example, 10 employers are listed below:

- National Institutes of Health
- Case Western University
- American Society of Hematology
- University of Alabama, Birmingham, School of Medicine
- Cornell University
- SUNY Oneonta
- TruCode Gene Repair, Inc.
- Norwich Pharmaceuticals
- ECI Technology
- University of Arkansas

The job descriptions include professors, postdoctoral fellows, research associates, instructors, industrial researchers, government officials, etc. It is expected that graduates from the proposed program will move on to similar positions in the public and private sector, as well as in industry.

- h)(3) *Similar Programs:*** Use the table below to list similar programs at other institutions, public and independent, in the service area, region and state, as appropriate. Expand the table as needed. **NOTE:** *Detailed program-level information for SUNY institutions is available in the [Academic Program Enterprise System \(APES\)](#) or [Academic Program Dashboards](#). Institutional research and information security officers at your campus should be able to help provide access to these password-protected sites. For non-SUNY programs, program titles and degree information – but no enrollment data – is available from [SED's Inventory of Registered Programs](#).*

A graduate degree explicitly with the title Biochemistry and Chemical Biology is not offered at other SUNY institutions, although the degree will programmatically align closely with traditional topics of biochemistry and biomolecular sciences. In terms of other Ph.D.-granting SUNY campuses, Stony Brook is offering a graduate program in Biochemistry and Structural Biology, as well as a training program in Chemical Biology (CBTP, <http://www.stonybrook.edu/chemistry/faculty/chembio-training/>), and SUNY Buffalo offers a Biochemistry Ph.D. program in the Medical School. A Biochemistry graduate program is also offered at SUNY ESF.

Several institutions in the region offer graduate programs in the general area of Biomolecular and Biomedical Sciences. These programs are often very broad in research scope and mostly housed in medical or veterinary schools. For example, a Ph.D. in Biological and Biomedical Sciences can be obtained from Cornell University, which is much more biologically oriented than the program we envision for Binghamton University. Cornell also offers a Ph.D. program in Chemistry and Chemical Biology, which is closely associated with the Chemistry Department. Syracuse University offers a Structural Biology, Biochemistry and Biophysics Ph.D. degree, which is interdepartmental and

most similar to this proposed program. A Biochemistry and Molecular Biophysics Ph.D. degree is offered by Columbia University, and a Biochemistry graduate degree at NYU.

Nationwide and internationally, a Ph.D. in Chemical Biology is offered by over 50 institutions, notable examples being Harvard University, Yale University, and UCSF. With the growing need for graduates in the Chemical Biology/Biochemistry field (see next paragraph, employment opportunities), it is expected that demand for the degree at Binghamton University should not be impacted by these competing institutions. Master's degrees in Chemical Biology are offered at 207 institutions.

Institution	Program Title	Degree	Enrollment
SUNY Stony Brook	Biochemistry and Structural Biology	Ph.D.	
SUNY Buffalo	Biochemistry	Ph.D.	21
SUNY ESF	Biochemistry	Ph.D./M.S.	6
Cornell University	Biological and Biomedical Sciences	Ph.D.	28
Cornell University	Chemistry and Chemical Biology	Ph.D./M.S.	
Syracuse University	Structural Biology, Biochemistry and	Ph.D.	
NYU	Biochemistry	Ph.D.	
Columbia University	Biochemistry and Molecular Biophysics	Ph.D.	

- h)(4) Collaboration:** Did this program's design benefit from consultation with other SUNY campuses? If so, what was that consultation and its result?

Not applicable.

- h)(5) Concerns or Objections:** If concerns and/or objections were raised by other SUNY campuses, how were they resolved?

2.4. Admissions

- a)** What are all admission requirements for students in this program? Please note those that differ from the institution's minimum admissions requirements and explain why they differ.

Admissions will be handled through the Slate admissions system of the graduate school, to which prospective students submit their application materials. Required application materials consist of the application form, transcripts, GRE scores, English language credentials, three letters of recommendation, a personal statement and a resume. While the GPA cutoff is 3.0, consistent with graduate school regulations, we expect the average applicant to have a GPA of 3.4-3.5, based on our experience with applications to the current biological chemistry track. The quantitative GRE scores may be of particular importance, with accepted students in the 50% and above range. For international applicants, we expect documentation of TOEFL (>105 or IELTS scores (> band seven).

It is planned that the steering committee of the new graduate program will handle admissions, with members from both Chemistry and Biological Sciences Departments. The members of this committee will be appointed by the chairs of the Chemistry and Biological Sciences Department. Because of the interdepartmental nature of the program, with faculty members contributing from other departments, the GAC will collaborate closely with admissions committees from other departments, most importantly Biological Sciences. The steering committee will review applications and make admissions decisions in communication with department chairs, as well as with consideration of the funding situation with respect to anticipated numbers of RA and TA lines. The committee will also uphold admission standards and strive for diversity in the pool of admitted students.

- b) What is the process for evaluating exceptions to those requirements?

Exceptions for GRE and language test scores can be made on a case-by-case basis, to be evaluated by the admissions committee. For example, our Kenyan applicants often cannot afford to take GRE exams. They also have excellent English language skills. Therefore, these test requirements are often waived for these applicants, but those exceptions are not guaranteed. The GAC will evaluate the totality of each case to find grounds for exceptions.

- c) How will the institution encourage enrollment in this program by persons from groups historically underrepresented in the institution, discipline or occupation?

The Chemistry Department already has a graduate recruitment committee (GRC), which is to assist with the recruiting activities of the new program, with input from the Biological Sciences Department. The Chemistry graduate program currently has six graduate students from under-represented minorities. This is in addition to nine students from Kenya. The Clifford Clark fellowship has been a useful tool for us to recruit students from under-represented groups, including African American and Hispanic. We expect that the proposed graduate program in Biochemistry and Chemical Biology will have similar numbers of students from under-represented groups. The GRC recruits these and other students through a visiting speakers program to four-year colleges in the Northeast of the US, GRE name-buys, a fall undergraduate conference with poster session, advertising at ACS conferences, and other recruiting activities.

The program will also coordinate with efforts of the Office for Graduate Recruitment and the Harpur College Dean's Office, including recruitment fairs dedicated to minority applicants, visiting colleges where minority students attend in large numbers, and by advertising the affordability of the Binghamton area in terms of cost of living.

- d) What is the expected student body in terms of geographic origins (i.e., same county, same Regents Region, New York State, and out-of-state); academic origins; proportions of women and minority group members; and students for whom English is a second language?

For domestic students, it is expected to recruit mainly from the Northeast of the US. Special emphasis will be on New York State, and in particular Binghamton University graduates, who like to stay in the area for post graduate studies. We have already built long-standing personal relationships to many four-year colleges in this region through individual faculty contacts, which we expect to be useful for recruiting. Examples of these colleges are SUNY Oneonta, SUNY Potsdam, Utica College, etc. We also recruit from surrounding states, most prominently Northern Pennsylvania.

In the existing Chemistry graduate program, the current student body (60 total) is highly diverse, consisting of 23.3% students of color, 5% of Hispanic origin, 28.3% students from Asia or with Asian heritage, and 5% students from India. Our student body is currently 52% international, with most of those students not having English as their native language. 42% of the students are female. It is expected that similar percentages will be achieved in the proposed Biochemistry and Chemical Biology graduate program.

Students who do not speak English as their native language will find strong support services on campus. With established ESL and TESOL programs, Binghamton University has ample resources to assist international students in increasing their English language skills.

2.5. Academic and Other Support Services

- a) Summarize the academic advising and support services available to help students succeed in the program.

Students will receive support through several mechanisms, depending on the stage of their career in the program. Between admission to the program and arriving in Binghamton, students will be advised by the admissions committee (GAC), in particular with respect to placement exams, class selection, finding a research adviser, preparation for

teaching duties, and living arrangements at Binghamton. The main contact will be the chair of the GAC. After arriving at Binghamton, students will initially be assigned to the chair of the graduate program committee (GPC) as their temporary adviser. This adviser will further counsel on class selection, potential makeup of placement deficiencies, and other issues regarding progress to degree. After the student has joined a research group, which should happen within the first year of joining the program, the research adviser takes over advising tasks. Throughout their career, students will be monitored by the GPC with regard to GPA (3.0 average is required for good academic standing), examinations (literature review and preliminary oral exam), and overall progress to degree, including research. The faculty committee selected by the student for the preliminary oral exam, consisting of four faculty members, will have a particularly important role in advising, because this committee will closely monitor research progress in progress reports, with written feedback to the student. This committee will also serve as the thesis defense committee, with the addition of an external examiner for the Ph.D. track of the program.

Advising with regard to career opportunities is primarily performed by the research adviser and the preliminary oral examination committee, but can be supplemented by advising from the Fleishman Center for Career and Professional Development at Binghamton University, which provides workshops related to career management, applications for positions interviews, etc. Furthermore, support is provided by graduate student clubs in both Chemistry and Biological Sciences Departments. It is expected that a separate graduate student club will form once the new program is in place. Other support can be provided by the International Student and Scholar Services Office (ISSS, for international students), the libraries, as well as health service on Binghamton University campus.

- b) Describe types, amounts and sources of student financial support anticipated. Indicate the proportion of the student body receiving each type of support, including those receiving no support.

Students on the Ph.D. track will be supported by academic year stipends either through teaching assistantships, or through research assistantships from funding from their research advisers. Currently, 13 laboratories associated with the proposed program have federal funding support (see faculty table, section 4). The stipend for the academic year is \$23,000 and is guaranteed for four years, as long as the student is in good academic standing. This financial support is supplemented in the summer through stipends from funding to research advisers, or competitively-awarded summer teaching assistantships. The recommended amount of summer salary is \$4,000. Tuition funding will be either through existing tuition allocation to the departments, or through research grants. Offers for admissions will not be made until funding for the stipend is secured for the first year, as identified through a detailed graduate student support plan, which will be updated every semester. Students on the M.S. and M.A. tracks do not typically receive financial support, although exceptions may be made if additional teaching lines are available and need to be filled.

2.6. Prior Learning Assessment

If this program will grant credit based on Prior Learning Assessment, describe the methods of evaluating the learning and the maximum number of credits allowed, **or check here [X] if not applicable**.

2.7. Program Assessment and Improvement

Describe how this program's achievement of its objectives will be assessed, in accordance with [SUNY policy](#), including the date of the program's initial assessment and the length (in years) of the assessment cycle. Explain plans for assessing achievement of students learning outcomes during the program and success after completion of the program. **Append** at the end of this form, **a plan or curriculum map** showing the courses in which the program's educational and, if appropriate, career objectives – from Item 2.3(b) of this form – will be taught and assessed.

NOTE: *The University Faculty Senate's [Guide for the Evaluation of Undergraduate Programs](#) is a helpful reference.*

The program will be assessed on an annual basis, the first assessment being three years after the start of the program, which is planned for Fall 2020. The Chemistry and Biological Sciences Departments have developed detailed assessment plans for their graduate programs. The assessment plan for the new program will be built on these existing plans, with modifications targeted toward the new program. The program director will be responsible for generating the assessment reports. The reports will be based on data collection through a variety of data mining

pathways, including results from coursework, exams, research, and output from scholarship. The assessment report will be based on the major program goals, as described in section 2.3:

- 1) Broad Knowledge
- 2) In-Depth Knowledge in Focused Area
- 3) Original Research Project
- 4) Professional Skills

The SLOs derived from these goals, which will be assessed in the report, are also described in detail in section 2.3, so they will not be repeated here.

The following tools will be used to generate data for assessment:

- Performance in core 4-credit courses (6 for Ph.D. and M.A., 4 for M.S.)
- Performance on placement exams
- Results from literature review exam
- Results from preliminary oral examinations in several categories
- Performance in the graduate seminar class
- Annual committee meetings and in-person interview with program director
- Results from research proposal
- Number of publications/presentations
- Thesis defense
- Teaching assistant evaluations
- Safety exams upon joining the program and at the beginning of each semester

Action plans will be generated if the results from the assessment report do not meet expectations.

Section 3. Program Schedule and Curriculum

Complete the **SUNY Graduate Program Schedule** to show how a typical student may progress through the program. This is the registered curriculum, so please be precise. Enter required courses where applicable, and enter generic course types for electives or options. Either complete the blank Schedule that appears in this section, or complete an Excel equivalent that computes all sums for you, found [here](#). Rows for terms that are not required can be deleted.

NOTES: The *Graduate Schedule* must include all curriculum requirements and demonstrate that expectations from in

Regulation 52.2 <http://www.highered.nysed.gov/ocue/lrp/rules.htm> are met.

Special Cases for the Program Schedules:

- For a program with multiple tracks, or with multiple schedule options (such as full-time and part-time options), use one Program Schedule for each track or schedule option. Note that licensure qualifying and non-licensure qualifying options cannot be tracks; they must be separate programs.
 - When this form is used for a multi-award and/or multi-institution program that is not based entirely on existing programs, use the schedule to show how a sample student can complete the proposed program. **NOTE:** Form 3A, [Changes to an Existing Program](#), should be used for new multi-award and/or multi-institution programs that are based entirely on existing programs. [SUNY policy](#) governs the awarding of two degrees at the same level.
- a) If the program will be offered through a nontraditional schedule (i.e., not on a semester calendar), what is the schedule and how does it impact financial aid eligibility? **NOTE:** Consult with your campus financial aid administrator for information about nontraditional schedules and financial aid eligibility.

Not applicable, traditional schedule.

- b) For each existing course that is part of the proposed graduate program, **append** a catalog description at the end of this document.

Catalog descriptions of the courses are attached in the appendix.

- c) For each new course in the graduate program, **append** a syllabus at the end of this document. ***NOTE:** Syllabi for all courses should be available upon request. Each syllabus should show that all work for credit is graduate level and of the appropriate rigor. Syllabi generally include a course description, prerequisites and corequisites, the number of lecture and/or other contact hours per week, credits allocated (consistent with [SUNY policy on credit/contact hours](#)), general course requirements, and expected student learning outcomes.*

Syllabi are attached in the appendix.

- d) If the program requires external instruction, such as clinical or field experience, agency placement, an internship, fieldwork, or cooperative education, **append** a completed [External Instruction](#) form at the end of this document

Not applicable, no external instruction required.

SUNY Graduate Program Schedule (OPTION: You can insert an *Excel version* of this schedule AFTER this line, and delete the rest of this page.)

Program/Track Title and Award: Biochemistry and Chemical Biology, Ph.D. _____

- a) Indicate **academic calendar** type: [X] Semester [] Quarter [] Trimester [] Other (describe):
 b) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
 c) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
 d) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1:				Term 2:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
BCHM 507 Advanced Biochemistry	4	X		4 credit graduate course from list in appendix D	4		
BCHM 508 Contemporary Methods in Biochemistry and	4	X		4 credit graduate course from list in appendix D	4		
Chem 593 Frontiers Chem. and Biochem.	1			Chem 593 Frontiers Chem. and Biochem.	1		
Bchm 597 Independent Study	3			Chem 592 Graduate Seminar	2		
				Bchm 598 Independent Study	1		
Term credit total:	12			Term credit total:	12		
Term 3:				Term 4:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
4 credit graduate course from list in appendix D	4			Bchm 599 Thesis Research	9		
4 credit graduate course from list in appendix D	4						
Bchm 598 Independent Study	1						
Term credit total:	9			Term credit total:	9		
Term 5:				Term 6:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Bchm 698 Pre-Dissertation Research	9			Bchm 698 Pre-Dissertation Research	9		
Term credit total:	9			Term credit total:	9		
Term 7:				Term 8:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Bchm 699 Dissertation Research	1			Bchm 699 Dissertation Research	1		
Term credit total:	1			Term credit total:	1		
Program Total:	Total Credits:62	Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Placement exams, literature review, preliminary oral exam, dissertation defense, thesis.					

This is a sample program schedule. The six 4-credit courses can be selected based on the course offerings shown in section 2.3g.

New: X if new course **Prerequisite(s):** list prerequisite(s) for the listed courses

SUNY Graduate Program Schedule (OPTION: *You can insert an Excel version of this schedule AFTER this line, and delete the rest of this page.*)

Program/Track Title and Award: Biochemistry and Chemical Biology, M.S. _____

- a) Indicate **academic calendar** type: [X] Semester [] Quarter [] Trimester [] Other (describe):
- b) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- c) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
- d) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1:				Term 2:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
BCHM 507 Advanced Biochemistry	4	X		4 credit graduate course from list in appendix D	4		
BCHM 508 Contemporary Methods in Biochemistry and Chemical	4	X		4 credit graduate course from list in appendix D	4		
Chem 593 Frontiers Chem. and Biochem.	1			Chem 593 Frontiers Chem. and Biochem.	1		
Bchm 597 Independent Study	3			Chem 592 Graduate Seminar	2		
				Bchm 598 Independent Study	1		
Term credit total:	12			Term credit total:	12		
Term 3:				Term 4:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Bchm 598 Independent Study	4			Bchm 599 Thesis Research	1		
Bchm 599 Thesis Research	4						
Chem 593 Frontiers Chem. and Biochem.	1						
Term credit total:	9			Term credit total:	1		
Term 5:				Term 6:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Term credit total:				Term credit total:			
Term 7:				Term 8:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Term credit total:				Term credit total:			
Program Total:	Total Credits: 34	Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Placement exams, literature review, thesis defense, Master thesis.					

This is a sample program schedule. The six 4-credit courses can be selected based on the course offerings shown in section 2.3g

New: X if new course **Prerequisite(s):** list prerequisite(s) for the listed courses

SUNY Graduate Program Schedule (OPTION: *You can insert an [Excel version](#) of this schedule AFTER this line, and delete the rest of this page.*)

Program/Track Title and Award: Biochemistry and Chemical Biology, M.A. _____

- a) Indicate **academic calendar** type: [X] Semester [] Quarter [] Trimester [] Other (describe):
- b) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- c) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
- d) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1:				Term 2:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
BCHM 507 Advanced Biochemistry	4	X		4 credit graduate course from list in appendix D	4		
BCHM 508 Contemporary Methods in Biochemistry and Chemical	4	X		4 credit graduate course from list in appendix D	4		
Chem 593 Frontiers Chem. and Biochem.	1			Chem 593 Frontiers Chem. and Biochem.	1		
Bchm 597 Independent Study	3			Chem 592 Graduate Seminar	2		
				Bchm 597 Independent Study	1		
Term credit total:	12			Term credit total:	12		
Term 3:				Term 4:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
4 credit graduate course from list in appendix D	4						
4 credit graduate course from list in appendix D	4						
Bchm 598 Independent Study	4						
Term credit total:	12			Term credit total:			
Term 5:				Term 6:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Term credit total:				Term credit total:			
Term 7:				Term 8:			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
Term credit total:				Term credit total:			
Program Total:	Total Credits:36	Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Placement exams, literature review, preliminary oral exam, dissertation defense, thesis.					

This is a sample program schedule. The six 4-credit courses can be selected based on the course offerings shown in section 2.3g

New: X if new course **Prerequisite(s):** list prerequisite(s) for the listed courses

Section 4. Faculty

- a) Complete the **SUNY Faculty Table** on the next page to describe current faculty and to-be-hired (TBH) faculty.
- b) **Append** at the end of this document position descriptions or announcements for each to-be-hired faculty member.

***NOTE:** CVs for all faculty should be available upon request. Faculty CVs should include rank and employment status, educational and employment background, professional affiliations and activities, important awards and recognition, publications (noting refereed journal articles), and brief descriptions of research and other externally funded projects. New York State's requirements for faculty qualifications are in in Regulation 52.2 <http://www.highered.nysed.gov/ocue/lrp/rules.htm>*

- c) What is the institution's definition of "full-time" faculty?

SUNY Faculty Table

Provide information on current and prospective faculty members (identifying those at off-campus locations) who will be expected to teach any course in the graduate program. Expand the table as needed. Use a separate Faculty Table for each institution if the program is a multi-institution program.

(a)	(b)	(c)	(d)	(e)	(f)
Faculty Member Name and Title/Rank (Include and identify Program Director with an asterisk)	% of Time Dedicated to This Program	Program Courses Which May Be Taught (Number and Title)	Highest and Other Applicable Earned Degrees (include College or University)	Discipline(s) of Highest and Other Applicable Earned Degrees	Additional Qualifications: List related certifications, licenses and professional experience in field
PART 1. Full-Time Faculty					
Ming An	50%	CHEM 534 (Bio-organic Chemistry), CHEM 583L (Chemical Biology)	Ph.D. University of California, Berkeley	Chemistry	Dr. An's laboratory performs research in organic, bio-organic, medicinal, biological, and pharmaceutical chemistry, as well as chemical biology and drug discovery. He is currently funded by the NIH.
Susan Bane	75%	CHEM 534 (Bio-organic Chemistry), CHEM 583L (Chemical Biology), CHEM 583S (Fluorescence)	Ph.D. Vanderbilt University	Biochemistry	Dr. Bane's research interests are in the area of chemical biology. She holds several patents and is currently funded by the NIH. Dr. Bane is director of the BU undergraduate biochemistry program.
Brian Callahan	25%	CHEM583M (Enzymes: Structure and mechanism)	Ph.D. University of North Carolina, Chapel Hill	Biochemistry	Research in Dr. Callahan's laboratory focuses on chemical biology of protein biogenesis and protein degradation. He is funded by the NIH and the DoD.
Nikolay Dimitrov	25%	CHEM582E, Electrochemistry	Ph.D. Bulgarian Academy of Sciences, Bulgaria	Chemistry	Dr. Dimitrov works on physical chemical characterization of electrochemical processes.
Puja Goyal	25%	CHEM585C (Computational Chemistry)	Ph.D. Chemistry, University of Wisconsin-Madison	Chemistry	Research in Dr. Goyal's group aims at obtain insights into chemical and biological systems through computation and theory.
Christof Grewer* (Program Director)	25%	CHEM585K (Chemical kinetics and the life sciences)	Ph.D. Goethe University, Frankfurt, Germany	Chemistry	Dr. Grewer's laboratory performs research in biophysical chemistry and electrophysiology, currently funded by the NSF and NIH.

Jennifer Hirschi	25%	BCHM507 (Advanced Biochemistry)	Ph.D. Texas A&M University	Chemistry	Research in Dr. Hirschi's lab involves the combination of experimental and computational techniques to study enzymatic mechanisms and drug design. She holds NSF funding.
Alistair Lees	25%	CHEM543 (Molecular Photochemistry)	Ph.D. University of Newcastle-Upon-Tyne, England	Chemistry	Dr. Lees works on photochemistry of transition metal complexes with emphasis on photoreactivity. He holds several patents.
Dennis McGee	50%	BIOL 514 (Cell and Molecular Biology), BIOL 521 (Immunology)	Ph.D. Texas A&M University	Immunology/cell biology	Dr. McGee's research as a mucosal immunologist focuses on the role of intestinal epithelial cells (IEC) in the intestinal immune response.
Laura Musselman	50%	BIOL 502 (Biochemistry), BIOL 513 (Cell and Mol. Biol. I)	Ph.D., University of Utah	Genetics	Dr. Musselman's research focuses on the investigation of metabolic processes and their biochemistry, in particular relating to diabetes. She holds NIH funding.
Julien Panetier	25%	CHEM585C (Computational Chemistry)	Ph.D. Heriot-Watt University, Edinburgh, UK	Computational Chemistry	Research in Dr. Panetier's laboratory focuses on computational methods to study solar energy conversion to fuels, based on mimicry of biological systems. he is funded by the NIH.
Wei Qiang	25%	CHEM586S (NMR Spectroscopy)	Ph.D. Michigan State University	Chemistry	Dr. Qiang's group performs research on the biochemistry and biophysics of amyloid peptides relevant in Alzheimers' disease. He holds a NIH grant.
Eriks Rozners (Chair, Chemistry Department)	25%	CHEM532 (Organic Synthesis)	Doctor of Chemistry (equivalent of Ph.D.) Riga Technical University, Latvia	Organic Chemistry	Research in Dr. Rozners' laboratory focuses on the chemistry and biochemistry of nucleic acids with a focus on elucidation of RNA's structure and function, funded by the NIH and NSF.
Karin Sauer (Chair, Biological Sciences Department)	25%	BIOL505 (Genomics and proteomics)	Ph.D. Max Planck Institute for Terrestrial Microbiology, Germany	Microbiology/ Biochemistry	Work in Dr. Sauer's laboratory is focused on the mechanism of biofilm formation and the development of bacterial resistance to treatments caused by biofilms. Her work is funded by the NIH.
Jeffrey Schertzer	25%	BIOL503 (Molecular Biology Laboratory)	Ph.D. McMaster University	Biochemistry	Dr. Schertzer is interested in the mechanisms by which bacteria interact with each other and with the environments in which they live. He is currently funded by the NIH.

Sozanne Solmaz	75%	BIOL502 (Biochemistry), CHEM583P (Prot. Biochemistry), CHEM592 (Graduate Sem.)	Ph.D. Max Planck Institute of Biophysics and Goethe University, Frankfurt	Biochemistry	Dr. Solmaz performs research on structural biology of nuclear pore complexes as gate keepers of the cell nucleus. Her research is funded by the NIH.
John Swierk	50%	CHEM584B (planned course), CHEM593 (Frontiers Chem. Biochem.)	Ph.D. The Pennsylvania State University	Chemistry	Dr. Swierk's group works in the field of inorganic and bio-inorganic chemistry. His work is funded by a PRF grant.
Mathew Vetticatt	25%	CHEM583C (Modern Catalytic Reactions)	Ph.D. Texas A&M University, College Station	Chemistry	Research in Dr. Vetticatt's group focuses on the determination of reaction mechanism using kinetic isotope effects. he currently holds NIH funding.
Part 2. Part-Time Faculty					
Part 3. Faculty To-Be-Hired (List as TBH1, TBH2, etc., and provide title/rank and expected hiring date)					
To be hired, at Assistant Professor level, planned for Fall 2021	50%	BCHM507 (Advanced Biochem.), BCHM508 (Meth. in Bioch.)			

Section 5. Financial Resources and Instructional Facilities

- a) What is the resource plan for ensuring the success of the proposed program over time? Summarize the instructional facilities and equipment committed to ensure the success of the program. Please explain new and/or reallocated resources over the first five years for operations, including faculty and other personnel, the library, equipment, laboratories, and supplies. Also include resources for capital projects and other expenses.

The Chemistry and Biological Science departments have existing faculty qualified to run in this proposed program (see faculty table, section 4).

Following its strategic plan, the Chemistry Department has hired eight faculty members at the interface between Chemistry and Biology over the past 10 years. Likewise, the Biological Sciences Department has four members working in the general field of Biochemistry. These faculty members perform research in the area of the proposed program and could accept graduate students from the program into their laboratory. Seven of the Chemistry faculty and four Biological Sciences faculty members are currently funded by the NIH and/or NSF. They have resources to support independent research by Master's/Ph.D. track students who are expected to enroll in the program. The expertise of these faculty members covers a broad range, from structural biology to nucleic acid chemistry, giving graduate students exposure to a large number of opportunities in Biochemistry and Chemical Biology research. All of these faculty members have published in journals that are relevant to the proposed program. One area of expertise currently missing is imaging/microscopy/fluorescence, as indicated by the external reviewers. This area of expertise will be covered by the new hire proposed for year one of the program, see "*Expenses Table*" below. This new faculty will be also instrumental in teaching the two new proposed graduate courses, Advanced Biochemistry and Contemporary Methods in Biochemistry.

Other expertise that is not covered by faculty members in the Chemistry Department can be supplemented by potential affiliated members of the program from other departments. The Biological Sciences Department has strengths in environmental genetics (EvoS program), microbial communities (biofilm group), mitochondrial genetics, and diabetes research, as potential contributors to the proposed graduate program. In addition, contributions from other schools at BU are expected (School of Pharmacy, Watson School of Engineering).

- b) Complete the five-year SUNY Program Expenses Table, below, consistent with the resource plan summary. Enter the anticipated academic years in the top row of this table. List all resources that will be engaged specifically as a result of the proposed program (e.g., a new faculty position or additional library resources). If they represent a continuing cost, new resources for a given year should be included in the subsequent year(s), with adjustments for inflation or negotiated compensation. Include explanatory notes as needed.

The Biochemistry and Chemical Biology program will share existing resources with the existing Chemistry and Biological Sciences graduate programs. For example, students who are currently on the Biological Chemistry track in the Chemistry program are expected to enter BU in the future through the new Biochemistry and Chemical Biology program. Thus, TA lines that are currently utilized for the Chemistry graduate student on the Biological Chemistry track can be utilized to fund graduate students in the new program. Therefore, no resources for new TA lines are requested.

Both, Chemistry and Biological Sciences Departments had recent success in attracting federal funding. 12 out of the 17 faculty members are currently funded by the NIH and/or NSF. Therefore, it is expected that a substantial number of students in the Biochemistry and Chemical Biology program will be funded by external grants on research assistantships.

At the start of the new program, it is planned to utilize the administrative structure of the Chemistry Department for administrative support. Specifically, Anne Hull (Instructional Support Specialist in Chemistry) will provide the

necessary administrative support for the program. While no new resources for an Administrative Assistant are requested at this time, it is possible that a part-time Administrative Assistant may be required in the future, depending on the rate of growth of the program.

SUNY Program Expenses Table

(OPTION: You can paste an [Excel version](#) of this schedule AFTER this sentence, and delete the table below.)

Expenses (in dollars)
Only new expenses are listed

Program Expense Categories	Before Start	Academic Year 1:	Academic Year 2:	Academic Year 3:	Academic Year 4:	Academic Year 5:	
(a) <i>Personnel (including faculty and all others)</i>	0	80,000	81,600	83,232	84,897	86,595	
(b) <i>Library</i>	0	0	0	0	0	0	
(c) <i>Equipment</i>	0	2,000	2,040	2,081	2,122	2,165	
(d) <i>Laboratories</i>	0	0	0	0	0	0	
(e) <i>Supplies</i>	0	0	0	0	0	0	
(f) <i>Capital Expenses</i>	0	0	0	0	0	0	
(g) <i>Other (Specify): Merit based stipend for MS student</i>	0	0	0	10,000 +11,310 tuition	10,000 +11,310 tuition	10,460 +11,536 tuition	
(g) <i>Other (Specify): Recruiting expenses</i>	6,000	6,000	4,000	3,000	3,060	3,121	
(g) <i>Other (Specify): Seminar series</i>	0	3,000	3,060	3,121	3,184	3,247	
(h) Sum of Rows Above	6,000	91,000	90,700	112,744	114,573	117,124	

Budget Justification

The values specified in the above table are costs that are incurred in addition to those of the current Chemistry graduate program.

- a) Personnel: If growth of the proposed graduate program proceeds as expected, we anticipate the need for a new faculty hire starting in year 1 of the program. The rationale for the new hire is to offer additional teaching resources for the two new proposed specialized graduate level classes (new Advanced Biochemistry course, and new Contemp. Methods in Biochemistry and Chemical Biology), as well as to offer research opportunity to be able to absorb the number of graduate students coming into the program. This will be especially important if the growth in the MS part of the program is higher than expected. The new faculty hire should be in the research area of imaging/microscopy/fluorescence, as suggested by reviewer 1. Binghamton University currently does not have strength in this research

area, despite its growing importance in life science research.

- b) Library: No need for new library resources are anticipated.
- c) Equipment: Equipment for the program is currently available as part of the core facilities in the Smart Energy Building, as well as shared resources in the TAE Health Sciences facility, and the ADL. Specialized equipment will be available in the laboratories of the faculty members who contribute to the program. This equipment is acquired through external funding. Therefore, no funds for acquiring equipment are requested, but a small annual budget (\$2,000) is requested for maintenance of equipment.
- d) Laboratories: Ample laboratory space is currently present in the Smart Energy Building, as well as the Science III Building. The Smart Energy Building has space for expansion to accommodate at least three additional faculty members and their laboratories. Therefore, laboratory space is not needed.
- e) Supplies: Office supplies for administrative purposes will be shared with the Chemistry graduate program.
- f) Capital: No capital expenses are necessary.
Expenses
- g) Other: It is expected that the MS track will be a substantial part of the new graduate program, with the possible admission of up to 5 MS students per year. In order to attract top students to this track, we request funds for one merit-based "thesis semester" MS stipend, plus tuition. We are planning to use this stipend as a tool to enhance the quality of MS theses, an award to recognize the best students, and as a recruiting tool. This stipend will be merit based and available for one MS student per semester. Each MS student can only receive this stipend for a maximum of one year. Therefore, not all MS students will receive this stipend. The rationale behind this stipend is that it will facilitate acceptance of MS offers by the best students. Second, it will give faculty members incentive to accept MS students into their laboratories. Overall, we anticipate that such a stipend could greatly enhance the MS track of the program, in both quality and quantity.
Stipend for MS student
- g) Other: We request \$6,000 for advertising the new program before its start. In year 2, this budget will be reduced to \$4,000 per year in the second year, and \$3,000 per year in the third year and thereafter. It will be critical for the new program to be able to advertise, in order to quickly build up a substantial applicant pool.
Recruiting Expenses
- g) Other: A seminar series will be important for students to be informed on the cutting edge research by other research groups outside of Binghamton University. A budget of \$3,000 is requested for this seminar series, which will be partly integrated with the Chemistry colloquium. However, additional budget will allow invitation of speakers nationwide, which is currently a limitation for the Chemistry colloquium because of budgetary issues.
Seminar

Section 6. Library Resources

- a) Summarize the analysis of library collection resources and needs *for this program* by the collection librarian and program faculty. Include an assessment of existing library resources and accessibility to those resources for students enrolled in the program in all formats, including the institution's implementation of SUNY Connect, the SUNY-wide electronic library program.

The Binghamton University library collection appears to be adequate for supporting the proposed program. If journal articles are not available in the library, they can be requested through inter-library loan.

- b) Describe the institution's response to identified collection needs and its plan for library development.

Not applicable.

Section 7. External Evaluation

SUNY and SED require external evaluation of all proposed graduate degree programs. List below all SUNY-approved evaluators who conducted evaluations (adding rows as needed), and **append at the end of this document** each original, signed [External Evaluation Report](#). **NOTE:** *To select external evaluators, a campus sends 3-5 proposed evaluators’ names, titles and CVs to the assigned SUNY Program Reviewer, expresses its preferences and requests approval.*

Evaluator #1 Name: Ellen S. Gawalt Title: Professor and Chair Institution: Duquesne University	Evaluator #2 Name: Arne Gericke Title: Professor and Chair Institution: Worcester Polytechnic Institute
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Section 8. Institutional Response to External Evaluator Reports

Append at the end of this document a single *Institutional Response* to all *External Evaluation Reports*.

Section 9. SUNY Undergraduate Transfer

NOTE: *SUNY Undergraduate Transfer policy does not apply to graduate programs.*

Section 10. Application for Distance Education

- a) Does the program’s design enable students to complete 50% or more of the course requirements through distance education? [] No [] Yes. If yes, **append** a completed *SUNY Distance Education Format Proposal* at the end of this proposal to apply for the program to be registered for the distance education format.
- b) Does the program’s design enable students to complete 100% of the course requirements through distance education? [] No [] Yes

Section MPA-1. Need for Master Plan Amendment and/or Degree Authorization

- a) Based on guidance on [Master Plan Amendments](#), please indicate if this proposal requires a Master Plan Amendment.
[] No [] Yes, a completed [Master Plan Amendment Form](#) is **appended** at the end of this proposal.
- b) Based on *SUNY Guidance on Degree Authorizations* (below), please indicate if this proposal requires degree authorization.

[] No [] Yes, once the program is approved by the SUNY Provost, the campus will work with its Campus Reviewer to draft a resolution that the SUNY Chancellor will recommend to the SUNY Board of Trustees.

SUNY Guidance on Degree Authorization. *Degree authorization is required when a proposed program will lead to a [new degree](#) (e.g., B.F.A., M.P.H.) at an existing level of study (i.e., associate, baccalaureate, first-professional, master’s, and doctoral) in an existing disciplinary area at an institution. Disciplinary areas are defined by the [New York State Taxonomy of Academic Programs](#). Degree authorization requires approval by the SUNY Provost, the SUNY Board of Trustees and the Board of Regents.*

List of Appended Items

Appended Items: Materials required in selected items in Sections 1 through 10 and MPA-1 of this form should be appended after this page, with continued pagination. In the first column of the chart below, please number the appended items, and append them in number order.

Number	Appended Items	Reference Items
	<i>For multi-institution programs, a letter of approval from partner institution(s)</i>	Section 1, Item (e)
	<i>For programs leading to professional licensure, a side-by-side chart showing how the program's components meet the requirements of specialized accreditation, Commissioner's Regulations for the Profession, or other applicable external standards</i>	Section 2.3, Item (e)
	<i>For programs leading to licensure in selected professions for which the SED Office of Professions (OP) requires a specialized form, a completed version of that form</i>	Section 2.3, Item (e)
	<i>OPTIONAL: For programs leading directly to employment, letters of support from employers, if available</i>	Section 2, Item 2.3 (h)(2)
A	<i>For all programs, a plan or curriculum map showing the courses in which the program's educational and (if appropriate) career objectives will be taught and assessed</i>	Section 2, Item 7
B	<i>For all programs, a catalog description for each existing course that is part of the proposed graduate major program</i>	Section 3, Item (b)
C	<i>For all programs with new courses, syllabi for all new courses in a proposed graduate program</i>	Section 3, Item (c)
	<i>For programs requiring external instruction, a completed External Instruction Form and documentation required on that form</i>	Section 3, Item (d)
D	<i>For programs that will depend on new faculty, position descriptions or announcements for faculty to-be-hired</i>	Section 4, Item (b)
E	<i>For all programs, original, signed External Evaluation Reports from SUNY-approved evaluators</i>	Section 7
F	<i>For all programs, a single Institutional Response to External Evaluators' Reports</i>	Section 8
	<i>For programs designed to enable students to complete at least 50% of the course requirements at a distance, a Distance Education Format Proposal</i>	Section 10
	<i>For programs requiring an MPA, a Master Plan Amendment form</i>	Section MPA-1

Appendix

Appendix A, Curriculum Map

Curriculum Map	CHEM 534, 583L, 583M, 583P, 583S, 586S, 585K, 583D, 585C, 584B	BIOL 502, 505, 501, 513, 514, 521, 523	BIOL 503, 504	CHEM 592, Literature Review	CHEM 593	Placement Exams, Safety Exams	Pre- liminary Oral Exam	CHEM 597, 598, 599, 696, 698, 699	Thesis Defense, Papers	Teaching Eval.
1. Broad knowledge and ability to understand biochemical information	X	X	X	X	X	X				
2. Writing, presentation and communication of biochemical science				X			X		X	
3. Specific knowledge of a specialized field of biochemistry	X	X	X	X	X		X	X	X	
4. Critical evaluation of primary literature				X			X	X	X	
5. Identify problem, develop hypothesis and design experiments			X	X			X	X	X	
6. Original published contributions to biochemical sciences								X	X	
7. Original research project				X				X	X	
8. Students will become skillful and professional teachers										X
9. Leadership skills								X	X	X
10. Safety, honesty and integrity						X		X	X	X

Appendix B, Catalog Description of Existing Courses

BIOL 502, Biochemistry

Cellular constituents: their role in life process. Structure and function of proteins/enzymes, membranes. Metabolism of carbohydrates, lipids, amino acids. Energetics and regulation of metabolism. Prerequisites* : BIOL 118, CHEM 107 and 108 (or 111), CHEM 231 and 332. 4 credits. Levels: Graduate, Undergraduate.

CHEM 534, Bio-organic Chemistry

Bioorganic chemistry is the application of the principles and tools of organic chemistry to the understanding of biological processes, which often ultimately leads to drug discovery. Topics include mechanisms of enzyme catalysis, cofactor (vitamin) mechanisms, drug design, introductions to medicinal chemistry and pharmacology, with special emphasis on the molecular mechanisms of drugs and drug targets. Textbook: Richard B. Silverman & Mark W. Holladay, 'The Organic Chemistry of Drug Design and Drug Action, 3rd edition (2014); Additional reading material will be posted on Blackboard as pdf files. Prerequisites: Organic Chemistry I-II (Chem 231 & Chem 332) required; Biochemistry helpful but not required. 4 credits. Levels: Graduate, Undergraduate.

CHEM582C Chemistry and the Environment

Chemistry and the Environment Course Description: Chemistry of the Environment (CHEM 482C/582C) offers a rigorous introduction to the chemical principles that govern the reactions, transport, effects and fates of chemical species in water, soil, air and living environments. We will pay special attention to the effects of technology and man's activities on the chemical composition and properties of the natural environment, and discuss contemporary topics as they relate to chemical processes. Additional requirements for CHEM 582C are term paper and research techniques. 4 credits. Levels: Graduate, Undergraduate.

CHEM 583L, Chemical Biology

Historically, work at the interface of chemistry and biology has been broadly grouped into Biological Chemistry (or Biochemistry). Then what is Chemical Biology? How is Chemical Biology different from traditional Biological Chemistry? A short answer is that scientists in this emerging field aim to spy on biomolecules in their native environments. These biomolecules include proteins, nucleic acids, carbohydrates, lipids, and natural products (i.e. the molecules of life). The challenge, as well as the attraction, of such an approach lies in the complexity of the in vivo environment. Imagine the difficulty of studying one kind of protein in a background of thousands (if not tens of thousands) of other kinds of proteins in a cell. How do you tell them apart? How do you keep track of the protein that you are interested in? Therefore, developing selective chemical tags by synthesis—the corner stone of chemistry—is the key enabling endeavor in chemical biology. The reward is that the information gained is 'the reality' that particular biomolecule is 'meant to experience'. This is in drastic contrast to the reductionist approach employed by traditional Biochemistry involving separation, purification, and reconstitution of biomolecules in artificial environments (science in vitro). As Chemical Biologists, we feel the efforts in studying biomolecules in isolated, controlled environments have paid off—that is, in some cases, we have enough reference information to go forward with, and we are looking forward to studying what these biomolecules are doing in their native environments—in living cells, tissues, animals, and people (science in vivo). Much of Chemical Biology is the development of small molecules as probes of biology and medicine. In some ways, all small molecule drugs (~ 90 % of all drugs) are

success stories of Chemical Biology because they must work in people—the ultimate in vivo setting. And vice versa, pharmacology is a rich ground for discovery of biology because in many cases we still don't know how drugs and toxins exactly work. Perhaps the most striking example involves the story of the mysterious compound cyclopamine (isolated from corn lily). As you might have guessed from its namesake, sheep that grazed on too much wild corn lily gave birth to one-eyed lambs. Deducing the target of action of cyclopamine led to the discovery of the hedgehog signaling network in cells. By shutting down this network, a new way to fight cancer was born. Textbook: no textbook, course reading material will be posted on Blackboard. Prerequisite: Organic Chemistry (Chem 231 & 332 or equivalent required), Biochemistry (Bio 301 & 302 or equivalent required), and Bioorganic Chemistry Chem 434/534 REQUIRED. 4 credits. Levels: Graduate, Undergraduate.

CHEM 583M, Enzymes: Structure and Function

CHEM 483M/583M. Title: Enzymes: Structure, function, and application. COURSE DESCRIPTION Topics for discussion include catalytic mechanisms, allostery, design of active-site probes, enzyme engineering, structure determination, and the influence of solvent water on enzyme activity. Readings are keyed to experimental techniques and draw from textbooks and from primary literature. The course is intended to provide students with an understanding of enzyme catalytic power, as well as an awareness of the growing importance of enzymes in the pharmaceutical and chemical industries. SUGGESTED TEXTBOOKS Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, by Alan Fersht Protein Structure and Function, by Gregory A. Petsko, Dagmar Ringe. 4 credits. Levels: Graduate, Undergraduate.

CHEM 583P, Protein Biochemistry

The goal of the course is to provide students with a basic understanding of three-dimensional structures of biological macromolecules. Students will learn about molecular structure determination techniques as well as the biological relevance of molecular structure-function relationships. Topics include macromolecular folding, binding interfaces and ligand interactions, illustrated by structures of selected membrane proteins, enzymes and ribozymes. Books: Biomolecular Crystallography: Principles, Practice and Application to Structural Biology, Bernhard Rupp, 1st edition. Garland Science 2009. ISBN-13: 978-0815340812 Textbook of Structural Biology, Anders Liljas, Lars Liljas, Jure Piskur, Göran Lindblom, Poul Nissen, Morten Kjeldgaard. World Scientific Publishing Company; Pap/Cdr edition 2009. ISBN-13: 978-9812772084. 4 credits. Levels: Graduate, Undergraduate.

CHEM 583S, Fluorescence

Fluorescence Spectroscopy for Chemical and Life Sciences. COURSE DESCRIPTION: General principles of absorption and fluorescence emission, characteristics of commonly used fluorophores, principles of steady state fluorescence techniques, time resolved techniques, fluorescence resonance energy transfer (FRET) fluorescent molecular sensors, fluorescence techniques in microscopy, and single molecule fluorescence spectroscopy. This course is designed for upper level undergraduate students and graduate students who use or plan to use fluorescent techniques in their research. FORMAT: Two 85-minute meetings per week, with out-of-class assignments, class presentations and a research paper. Text: "Molecular Fluorescence: Principles and Applications" by Bernard Valeur. PREREQUISITES: CHEM 351 or CHEM 361 and BCHM 302. 4 credits. Levels: Graduate, Undergraduate.

CHEM 586S, NMR Spectroscopy

Description: Functions of molecules are determined by their structural and dynamic characteristics, which are usually investigated using spectroscopic methods. The nuclear magnetic resonance (NMR) spectroscopy provides the most powerful technique to assess the molecular details in chemical sciences. This special topics course will cover both

fundamental and application aspects in the state-of-the-art NMR technology. Lectures include (1) physical principles in NMR spectroscopy, (2) spectral simulation and analysis for molecules, (3) NMR-based molecular structural determination and modeling and (4) the most-recent technique developments and applications in NMR. Format: The class meets on Mondays and Wednesdays every week, for 1.5 hours each. Books: The course will use original materials and literature, and a list of reference books will be recommended. Powerpoint presentations will be uploaded on MyCourse after lecture. Software: NMR simulation and structural modeling software will be introduced. Softwares are free to download. Detailed instructions will be provided. 4 credits. Levels: Graduate, Undergraduate.

CHEM 585K, Chemical Kinetics and the Life Sciences

CHEMICAL KINETICS AND THE LIFE SCIENCES COURSE DESCRIPTION: Elementary biological processes take place with time scales ranging from picoseconds to 10s of years. Understanding the kinetics of these elementary processes is fundamental to the comprehension of the workings of living organisms. This course will introduce the basic concepts of chemical kinetics and their application to the life sciences. Topics to be covered will include elementary kinetic equations, enzyme kinetics, complex reactions, kinetic methods, transitions state theory, relaxation phenomena, and the application of kinetics to biological systems with several case studies. FORMAT: The class meets twice per week for 1.5 hours each. Grading will be through a midterm and an original literature-based project with a final oral presentation. BOOKS: KINETICS FOR THE LIFE SCIENCES by H. Gutfreund, Cambridge University Press, can be used as a guideline, but the course will also use original literature. PREREQUISITE: A strong interest in Sciences at the interface between Chemistry, Physics, and Biology. 4 credits. Levels: Graduate, Undergraduate.

BIOL 505 Genomics and Proteomics

Global analysis of gene expression at mRNA levels, of protein modifications and protein interactions in relation to change in cellular or physiological condition. Prerequisite: BIOL 301 or 401 or consent of the instructor. Prerequisite: BIOL (BCHM) 301 or 401, 501, 503, or 513. 4 credits. Levels: Graduate, Undergraduate.

BIOL 501. Molecular Genetics

Focuses on how nucleic acids convey and express genetic information. Topics include DNA replication, recombination and repair; RNA structure, synthesis, processing, regulation of transcription; protein synthesis, processing and regulation of translation in prokaryotic and eukaryotic systems. Prerequisites: BIOL 117 or 118 and CHEM 111 (or 107 or 108), 231, BIOL/BCHMK 302 or 403 are not prerequisites. Corequisites: CHEM 332. 4 credits. Levels: Graduate, Undergraduate.

BIOL 513, Cell and Molecular Biology I

Analysis of important systems in molecular biology using primary literature. Presentations by students as well as faculty. Prerequisite: course in molecular biology (for example, BIOL 501). 4 credits. Levels: Graduate, Undergraduate.

BIOL 514, Cell and Molecular Biology II

Analysis of important systems in cell biology using primary literature. Presentations by students as well as faculty. Prerequisites: course in cell biology (for example, BIOL 311) and one in molecular biology (for example, BIOL 301 or 401/501) recommended. 4 credits. Levels: Graduate, Undergraduate.

BIOL 521, Immunology

Introduction to the immune mechanisms, which protect the body from invading microorganisms and disease. Topics include antibody production and function, cell-mediated immunity, hypersensitivity and cytokines and their relation to disease. Prerequisites: one of the following: BIOL (BCHM) 301 or 401, 302 or 403, 311, 314. 4 credits. Levels: Graduate, Undergraduate.

CHEM 583D, Chemistry in Drug Discovery

This special topics course in organic chemistry will focus on chemical approaches to meeting new challenges in drug discovery and biomedical research. In the past two decades, impressive advances in the theory and practice of drug discovery have not resulted in more (or better) drugs coming off the pipe-line. We will discuss this paradox and explore its root causes by retracing questions such as: Is the old model of drug discovery fading away? (And why?) How to target the non-druggable drug targets? And how can organic chemists—the old vanguard of drug discovery—help to turn the tide? This course will also reflect on ‘What is chemical biology?’ and argue that all small molecule drugs are success stories of chemical biology because they must work in people—the ultimate in vivo setting. And vice versa, pharmacology (i.e. the study of what drugs are doing in people) is a rich ground for discovery of biology because in many cases we don’t know how drugs and toxins exactly work PREREQUISITE: Organic 2 (332) and Organic Lab (335) . 4 credits. Levels: Graduate, Undergraduate.

BIOL 558, Biostatistics

Basic statistics topics, including probability and distribution, experimental designs and hypothesis testing (t-test and ANOVA) and linear regression. Includes lectures and the use of computer statistical software. Teaches biology graduate students basic theory and practical skills in statistics. BIOL 117 and 118, and MATH 147 or 148. 4 credits. Levels: Graduate, Undergraduate.

BIOL 523, Cancer Biology

Focus on the biological basis for cancer, the genetic and cellular mechanisms involved and contemporary treatment options. The material will be conveyed using lectures and student presentations. Two student presentations will be required and comprise 20% of the grade. Several short papers will be required and comprise 50% of the grade. Prerequisites: Either BIOL 311, Cell Biology, or BIOL 301, Molecular Genetics, and either BIOL 513, Cell and Molecular Biology I, or BIOL 514, Cell and Molecular Biology II. Levels: Graduate, Undergraduate.

CHEM 532, Organic Synthesis

Introduces advanced students to fundamental principles and concepts of organic synthesis with emphasis on modern strategies toward efficient synthesis of compounds of biologic interest. Topics include reactions of carbonyl groups, enolates, olefins and other key substrates; metal catalyzed processes for C-C and C-X bond formation; oxidation and reduction; rearrangements and cycloadditions. Final weeks of course concentrate on classical syntheses of complex natural products. 4 credits. Levels: Graduate, Undergraduate.

CHEM 543, Molecular Photochemistry

CHEM 443/543. MOLECULAR PHOTOCHEMISTRY COURSE DESCRIPTION: Introduction to modern molecular photochemistry of organic, inorganic, and organometallic systems. Excited states, photophysical processes, energy transfer, electron transfer, substitutional photochemistry, chemiluminescence. FORMAT: Three hours of lecture per week. Taught simultaneously as CHEM 443/CHEM 543. PREREQUISITES: CHEM 351. 4 credits. Levels: Graduate, Undergraduate.

CHEM583C, Modern Catalytic Reactions

Catalytic reactions are the metaphorical engine of modern-day organic synthesis. This course will introduce you to the state-of-the-art methodology in contemporary catalysis in organic chemistry. The majority of the material covered will be catalytic reactions published after the year 2000. The course will cover several classes of reactions in the areas of organocatalysis and transition-metal catalysis that important to the synthesis of complex pharmaceuticals and fine chemicals. A textbook is not required for the course since the course will be taught directly from journal articles and reviews. 4 credits. Levels: Graduate, Undergraduate.

CHEM 585C, Computational Chemistry

This course is aimed at teaching students how to carry out computations to understand experimental observations and make predictions related to diverse chemical systems. Besides learning the theory behind a variety of computational methods, students will get hands-on experience in solving problems in Chemistry using computational tools. 4 credits. Levels: Graduate, Undergraduate.

CHEM 542, Physical Inorganic Chemistry

Modern spectroscopic techniques and inorganic systems; molecular symmetry and group theory in chemical applications; reaction mechanisms. 4 credits. Levels: Graduate, Undergraduate.

CHEM 592, Graduate Seminar

GRADUATE SEMINAR COURSE: Seminar discussion of current research in chemistry. Students prepare and present a research seminar based on a number of papers devoted to a single topic. A poster presentation is also made on the research topic. REQUIRED OF ALL CHEMISTRY GRADUATE DEGREE CANDIDATES. FORMAT: One meeting per week. EVALUATION: Quality of oral and poster presentations. BOOKS: None. Science Library used extensively. PREREQUISITES: Graduate Standing in Chemistry. 2 credits. Levels: Graduate.

CHEM 593, Frontiers in Biochemistry

CHEM 593 FRONTIERS IN BIOCHEMISTRY. 1 cr. COURSE DESCRIPTION: Seminars on current topics in chemistry. Students attend presentations, participate in discussion and write reports. Visiting speakers are included. May be repeated for credit, to be counted toward fulfilling residency requirement; may not substitute for specified course requirements (including seminars). Required of all chemistry graduate degree candidates; two semesters required for all students. FORMAT: One meeting per week on Fridays. Satisfactory/Unsatisfactory grading only. BOOKS: None. PREREQUISITES: Graduate standing in chemistry. 1 credits. Levels: Graduate.

Note that this course currently has the title "Frontiers in Chemistry", which will need to be renamed.

BIOL 503, Molecular Biology Laboratory

Molecular biology laboratory techniques: manipulation of microorganisms, preparation of DNA, sub-cloning DNA into vectors, sequencing of DNA, detection of specific DNA sequences with the polymerase chain reaction (PCR), and study of tissue-specific gene expression using reverse-transcription-PCR. Analysis of data using computer programs will be emphasized [Subject to change]. Format: Lecture and laboratory. Prerequisites or Corequisites: BIOL/BCHM 301, 401, or 501. Simultaneously taught: *denotes primary course BCHM425 *BIOL425 BIOL503. 2 credits Levels: Graduate, Undergraduate,

BIOL 504, Biochemistry Laboratory

Laboratory techniques including the purification of proteins, characterization of enzymes and other methods of analysis. One one-hour lecture and one four-hour laboratory per week. Prerequisite or corequisite: BIOL 502 or equivalent. 2 credits Levels: Graduate, Undergraduate.

**Pre-requisites for undergraduate courses were copied from the course description from the Binghamton University bulletin, but will not be enforced for the graduate level of the course.*

Appendix C, Catalog Syllabi of New Courses

State University of New York at Binghamton

Binghamton University

Department of Chemistry

Advanced Biochemistry, BCHM 507

Summary. This course is an advanced biochemistry for graduate students. The course will build on topics of biochemistry from undergraduate courses. Topics covered will include protein composition and structure, structure of DNA, RNA, and flow of genetic information, bioinformatics, enzymes structure and function, regulation, carbohydrates, lipids and membranes, membrane proteins, metabolic pathways, oxidative phosphorylation, and biosynthetic pathways.

Instructor. TBA

Office Hours. TBA

Class Times. TBA

Help Sessions. TBA

Textbooks. TBA

For this 4-credit course students are expected to do at least 9.5 hours of course-related work each week during the semester, in addition to lectures and discussions. These activities include: Completing assigned readings, studying for tests and examinations, preparing written assignments, completing internship or clinical placement requirements, and other tasks that must be completed to earn credit in the course

Evaluation. Students will be evaluated based on exams and homework. *The instructor reserves the right to amend these grading criteria for individual students to accommodate extraordinary health, personal, or family circumstances that are documented authoritatively in writing.*

Term Examinations. There will be two term examinations – one in class and one take home exam. Each will count 100 points towards the final grade. Exams will consist of questions designed to evaluate student understanding of topics from the lecture and assigned readings.

Comprehensive Final Exam. There will be a **mandatory comprehensive final exam**, which will count for 200 points towards the final grade. The date and time of the final exam will be sent to the class as soon as it is scheduled by the registrar's office.

Homeworks and Quizzes. There will be six (6) problem sets assigned throughout the semester, worth a total of 200 points.

Extra Credit. At the instructor's discretion and without prior announcement, opportunities for extra points will be offered during lecture. These opportunities will only be offered during lecture to the students in attendance that day.

Percentage grades at the end of the semester will be calculated by dividing the sum of the student's points over the entire semester by the maximum total points available. Percentage grades will be assigned a letter grade according to the scale shown below. With this procedure some students will be a few points shy of the next letter grade. This is not grounds to appeal for a higher letter grade. Please note that this system does **not** penalize high-achieving students from helping others. The instructor reserves the right to adjust this scale, schedule, and syllabus in general.

In consultation with the instructor, graduate students will be required to prepare an 8-10 page review-style paper, including figures, on a topic in inorganic chemistry relevant to their research interests. Citations should be in ACS format (without titles) and do not count towards the page limit. Graduate students should utilize the ACS template for articles (pubs.acs.org/page/jacsat/submission/jacsat_templates.html). This paper will count for an additional 200 points towards the final grade. The topic must be approved by the instructor by September 15th, with an outline of the paper due by November 1st. The final paper is due on or before December 7th. The organization of content, written English, outline, and quality of discussion will be considered towards the points awarded. Student are encouraged to utilize the resources available from the Binghamton University Writing Center (binghamton.edu/writing/writing-center/) to help craft the paper.

Summary of point totals to determine final grade	
Term Exams (100 points each)	200
Problem Sets (200 points possible)	200
Cumulative Final Examination	200
8-10 papers	200
Maximum total number of points	800

Percentage	Grade
94.9 – 100	A
90.0 – 94.9	A–
85.0 – 89.9	B+
80.0 – 84.9	B
76.0 – 79.9	B–
71.0 – 75.9	C+
66.0 – 70.9	C
60.0 – 65.9	C–
50.0 – 59.9	D
< 50.0	F

Re-grade policy. Students will have one week from the day they receive their graded problem set or exam to request a re-grade. If the re-grade request involves an error in adding partial credit points, the instructor record the new total and return the assignment back to the student. If the re-grade request involves a possible error in assigning points to the student's work, the **entire assignment will be re-graded and may result in a lower total score than before the re-grade.**

Please note that there will be no re-grade requests for assignments written in pencil.

myCourses (Blackboard). Daily monitoring of myCourses page (<https://mycourses.binghamton.edu/>), as well as your BU email account, is essential for obtaining course-related information. Lecture notes, course supplements, and important announcements for this course. Failure to check this resource is NOT a valid excuse for not receiving information communicated via this pathway. Also, all course materials will be available through this website. In addition, homework's, quizzes, and practice examination materials will be posted through this method. Occasionally, review sessions may be scheduled on my courses as a discussion thread.

Email Policy. If necessary, messages will also be sent to your BU email account. Students are expected to check their email on a frequent and consistent basis in order to recognize that certain communications may be time critical. Emails will be responded within 24h during regular work week. The instructors will not email you everything you missed in class if you did not attend that day. Check myCourses for lecture notes and course schedule. Any high priority/urgent message sent will be returned as soon as possible during the regular workweek.

Attendance in Classes. Per the university bulletin, "*Students are expected to attend all scheduled classes, laboratories and discussions.*" Occasionally extra credit (see above) or topics not covered in the reading may be presented during lecture. Excessive tardiness may be subject to additional academic penalties, including being denied the right to take the final exam, at the instructor's discretion.

Students at Binghamton University have the opportunity to participate in many extracurricular activities that either contribute to the quality of their graduate experience or promote their post-graduate careers. At times, students' participation requires them to be absent from regularly scheduled classes, labs, or recitations. Students are responsible for all work missed. According to the University Policy and Procedure, each student is responsible for notifying the instructor of a potential absence at the beginning of the term for events already scheduled, and as soon as possible but not less than one week before those activities scheduled once the term begins. I will make every effort to accommodate student with valid excuses for absences.

Students with Religious Obligations. We will make every effort to accommodate students with Religious obligations for any part of this course. However, students must notify the instructor at the beginning of the semester of the requirements. For more information, refer to the University's policy for absences due to religious obligations in Section 224- a. Students unable because of religious beliefs to attend classes on certain days. (as amended by Laws of 1992, chapter 278) Visit <http://www.binghamton.edu/academics/provost/faculty-staff-handbook/handbook-vii.html#B> for more information.

Students with Disabilities. Students needing accommodations to insure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they're aware of their need for such arrangements. Students must notify the instructor at the beginning of the semester of the requirements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119.

Electronic Device Policy. Smart/Cell phones and other similar devices must be turned off before entering the lecture room.

- Students using any of these devices during lecture may be asked to leave the room.
- Use of any of these devices during exams will be considered cheating and subject to the penalties outlined below.

Academic Dishonesty. The fairness of grading in The Department of Chemistry at Binghamton University's courses depends upon all students adhering rigorously to the fundamentals of academic integrity. All students are disadvantaged by academic dishonesty whether they are the honest ones or the dishonest. Honest students may find that their hard work is not properly recognized. Those who cheat may lose the essential connection between the amount they learn and the grade they receive, ultimately resulting in lack of preparation or qualification for their chosen life career. And certainly, if they are caught, they can be punished with anything from a zero on the assignment up to dismissal from the University, depending on the severity.

While a student is free to discuss the material in lecture and homework with others in the class, all assignments turned in must contain only the student's original work. Students found to be cheating on a problem set will receive at minimum an automatic zero for that assignment and a 5% reduction in total problem set points. At minimum, students caught cheating on an exam will receive a zero for the exam and a reduction in grade. All violations in academic integrity will be reported to the Harpur College Academic Honesty Committee.

Students are advised to review the Student Academic Honesty Code found in the University Bulletin and the information at <http://www2.binghamton.edu/student-handbook/rules.pdf>, <http://www2.binghamton.edu/grad-school/faculty-and-staff/policy/academic-honesty-policy.html> and <http://www2.binghamton.edu/student-handbook/rules-governing-academic-life.html> .

Maintain a Safe and Professional Learning Environment. The Chemistry Department strives to give our students a good learning experience. We respect our students and require that our students respect our faculty, staff and fellow students. We as instructors and you students in this class share a responsibility to develop and maintain a positive teaching and learning environment for everyone. We take this responsibility very seriously and will inform members of the class if their behavior makes it difficult to maintain this environment. You are asked to respect the learning needs of your classmates and assist your instructors in doing the same.

Code of Conduct, Section 1, Rules of Student Conduct #17 states that the following behavior is prohibited: *Disorderly or disruptive conduct that interferes with the normal operations of the University or infringes on the rights of others* and the **University Bulletin**, under Classroom Discipline, states: Any instructor may exclude from attendance any student who, in the instructor's judgment, has seriously impaired the class's ability to achieve the objectives of the course.

Therefore, this is to serve as a warning that disruptive behavior is not conducive to a learning atmosphere for the rest of the students and it is not going to be tolerated.

Please note that if you are having trouble in class, you are free to consult me. You may also take advantage of the tutoring center (<http://www2.binghamton.edu/clt/tutoring.html>). If you experience other frustrations the Counseling Center is an excellent resource and it is open to all students (<http://www2.binghamton.edu/student-life/student-services/student-affairs/counseling-center.html>).

Where to go for help. Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. The

source of symptoms might be largely related to your course work; if so, I invite you to speak with me (or your other professors) directly. However, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance, and may require additional professional support. Binghamton University provides a variety of support resources: the Dean of Students Office and University Counseling Center offer coaching on ways to reduce the impact to your grades. Both of these resources can help you manage personal challenges that impact your well-being or ability to thrive at Binghamton University. Accessing them, especially early on, as symptoms develop, can help support your academic success as a University student.

In the event I feel you could benefit from such support, I will express my concerns (and the reasons for them) to you and remind you of our resources. While I do not need to know the details of what is going on for you, your ability to share some of your situation with me will help me connect you with the appropriate support.

Tentative lecture schedule:

Date	Topic
08/21 Wed	Organizational Meeting
08/23 Fri	Fundamentals
08/26 Mon	Protein structure , amino acids, primary and secondary structure
08/28 Wed	Protein structure , tertiary and quaternary structure
09/30 Fri	Protein structure , protein folding
09/02 Mon	<u>No class, Labor Day</u>
09/04 Wed	Protein structure , structure determination, x-ray
09/06 Fri	Protein structure , structure determination, NMR, other methods
09/09 Mon	Proteins and proteomes , analysis and purification
09/11 Wed	Immunology methods
09/13 Fri	Nucleic acids and genetic information , structure of DNA
09/16 Mon	Nucleic acids and genetic information , from DNA to protein
09/18 Wed	Recombinant DNA technology
09/20 Fri	DNA replication , polymerases
09/23 Mon	DNA replication , mutagenesis and knockouts
09/25 Wed	Transcription
09/27 Fri	Exam 1
9/30 Mon	<u>No class, Rosh Hashanah</u>
10/02 Wed	Transcription , RNA processing
10/04 Fri	Translation , genetic code and the ribosome
10/07 Mon	Translation , targeting and the control of gene expression
10/09 Wed	<u>No class, Yom Kippur</u>
10/11 Fri	Enzymes , basic concepts and kinetics

10/14	Mon	Enzymes , catalytic strategies	
10/16	Wed	Enzymes , regulatory strategies	
10/18	Fri	Carbohydrates	
10/21	Mon	Carbohydrates	
10/23	Wed	Lipids and Membranes , biosynthesis	
10/25	Fri	Exam 2	
10/28	Mon	Lipids and Membranes , membrane proteins	
10/30	Wed	Lipids and Membranes , channels and pumps	
11/01	Fri	Metabolism	
11/04	Mon	Metabolism , glycolysis and gluconeogenesis	
11/06	Wed	Metabolism , citric acid cycle	
11/08	Fri	Oxidative phosphorylation	
11/11	Mon	Nucleotide biosynthesis	
11/13	Wed	Bioinformatics	
11/15	Fri	Structural biology , computational methods	
11/18	Mon	Presentations	
11/20	Wed	Exam 3	
11/22	Fri	<u>No class, Thanksgiving</u>	
11/25	Mon	Presentations	
11/27	Wed	Presentations	
11/29	Fri	<u>No class, Thanksgiving</u>	
12/02	Mon	Presentations	
12/04	Wed	Review	
12/?		Final Exam, TBD	(cumulative, all chapters)

COURSE NAME: *Contemporary Methods in Biochemistry and Chemical Biology* BCHM 508,— A hands-on module-based laboratory course to prepare graduate students for advanced research-intensive degree programs in Biochemistry and Chemical Biology.

INSTRUCTORS: TBA

TIME & PLACE:

Lectures will be in the SN building, RM (TBA)

Laboratory work will be carried out in the Health Science Core

COURSE OBJECTIVES:

- (1) Introduce experimental and computational techniques relevant to quantitative, mechanism-based research on living systems
- (2) Familiarize students with ethical standards expected of scientific researchers. During each module, instructors will integrate practices/principles of Responsible Conduct of Research.
- (3) Train graduate students to use relevant equipment and instrumentation in the Chemistry Department and Health Sciences Core

SKILLS TO DEVELOP: Application of the new concepts requires students to

- (1) Develop testable hypotheses
- (2) Design of controlled experiments to test hypotheses
- (3) Critical evaluation data and problem solving strategies
- (4) Refine scientific communication skills, written and oral

Course Format:

Each module will be a combination of in-class lecture and in-lab experimentation. Minimum of four one-hour sessions each week.

Module 1: Recombinant protein expression in E. coli and affinity purification (3 weeks)

Module 2: Experimental approaches to characterize protein structure and function (3 weeks)

Module 3: Chemical tools for bioconjugation (3 weeks)

Module 4: Mammalian cell culture and microscopy (3 weeks)

Module 5: Computational tools for biomolecular structure analysis (3 weeks)

CREDITS: This course is a **4-credit course**.

Appendix D, Job advertisement for the faculty to be hired

Assistant Professor in Biochemistry and Chemical Biology

State University of New York at Binghamton

The Chemistry Department at the State University of New York at Binghamton anticipates one tenure-track faculty opening in **Biochemistry and Chemical Biology**. The position is at the Assistant Professor level, preferably with research interests in mechanistic, computational and imaging aspects of biochemistry and chemical biology. The Department's strategic plan anticipates growth with emphasis in biological, materials, and environmental research. The Department (binghamton.edu/chemistry) has a commitment to high quality research and excellence in doctoral and undergraduate education. Applicants must post a cover letter, CV, detailed research plan, and a statement of teaching philosophy, and have two letters of reference, submitted online at:

<http://binghamton.interviewexchange.com/jobofferdetails.jsp?JOBID=xxxx>. *Binghamton University is an Affirmative Action/Equal Opportunity Employer.* Applications will be considered starting xxxx.

Appendix E, External Reviewer Reports

The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: SUNY Binghamton

Evaluator Name (Please print.): Ellen S. Gawalt, Ph.D.

Evaluator Title and Institution: Hillman Endowed Chair, Professor and Department Chair



Evaluator Signature:

Proposed Program Title: Biochemistry and Chemical Biology

Degree: M.S. and Ph.D.

Date of evaluation: 9/30/19 and 10/1/19

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation**. Address the program's academic rigor and intellectual coherence.

Purpose

The purpose of the new program is to design and deliver a transdisciplinary program in biochemistry which is tailored to current student demand and hiring needs in the biomedical industrial space in the US. Additionally, many of the faculty in the biology and chemistry departments have recently been successful in attaining grants which are related to biochemistry or chemical biology. These grants bring in substantial funding, which is important to the University and the Departments. These faculty represent a young, vibrant portion of the Departments and should be recognized and supported. The separate program will help recruit students for the research endeavors of these recently hired and funded faculty and provide retention incentive for these faculty who may be attracted to other universities.

Structure

Organizational Structure and Program Administration: The proposed structure of the program is minimalistic with only a program director and relies heavily on the current structures of the Department of Chemistry. Since the vast majority of the proposed faculty are from the Department of Chemistry this is somewhat understandable but is most likely not a long-term tenable situation. This reviewer recommends that they set up a Program Committee with even representation from both departments to support the director. This committee will act in much the same way that the undergraduate committee does, making curricular and admissions decisions. Also, the Director will have to work closely with both Department Chairs. As new biology faculty are hired in this area, and become part of the program, the Director position may rotate to Biology. Additionally, criteria for faculty membership in the program must be established.

Curricular: The current proposal utilizes the current course offerings based on their current resources. However, the faculty are missing an opportunity to look forward and design a curriculum that will best serve the students for the next 10 years. A current biochemistry curriculum at a minimum should include courses that the NIH training grants demand such as, proposal writing, ethics, and entering mentoring. The faculty should think about what would make their student marketable such as microscopy, techniques-based courses, and bioinformatics. Some faculty expressed an interest in a hands-on techniques course. The number of classes required is reasonable and will give the students a solid foundation in the area. However, there are no required course(s) that could serve as a foundation for the entire program.

Requirements

Admission Requirements: The proposal did not give strict admission requirements but proposed using the chemistry graduate admissions committee and their guidelines which targets a 3.5 GPA with a 50% on the GRE and a 90 on the ToEFL. However, I would recommend using a joint committee for this purpose rather than relying on the chemistry committee.

Curriculum and graduation requirements were aligned with standard MS and PhD requirements in chemistry departments. This requires coursework, literature review examinations, safety and entrance exams, oral examinations, an original proposal and dissertation writing and defense. However, it is not clear if the chemistry milestones and biology milestones are consistent. The milestones and requirements should be clearly spelled out in the proposal for this program.

Program Evaluation

The program assessment and evaluation is based on the current Department of Chemistry plan which evaluates student performance on written and oral exams, number of publications, and students graduated. This is a standard assessment plan for a graduate program. The information will be used to make curriculum and administrative changes if necessary.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

Biochemistry is an official subdiscipline of chemistry according to the American Chemical Society and biologists view biochemistry, molecular biology, and microbiology as closely related subdisciplines. Many schools do have Departments of Chemistry, Departments of Chemistry and Biochemistry or related programs. Often a Department of Biochemistry will reside within a medical school, while an interdisciplinary program will be freestanding utilizing faculty from many departments. This program will broadly cover many of the research topics within biochemistry and will not focus on a specific research or educational niche.

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

The self-assessment plan is dependent on the Department of Chemistry plan which is a standard graduate evaluation based on exam success, degree completion and publication. However, the plan lacks details about the feedback loop in which they will use the information to improve the program. Also, the proposal should include the standard external reviews, which occur every seven years.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.

This program will derive its faculty from the Departments of Chemistry and Biology so there will be intimate interactions with both programs and require the direct support of the program by these programs with financial and talent resources. Both Departments have agreed to use teaching assistant lines for the program based on the faculty involved. Additionally, the faculty will continue to teach courses that students from both Departments and the program will enroll. The largest opportunity and potential obstacle lies in the need to jointly administer the program. This program provides the opportunity for an energetic faculty to design and implement an innovative curriculum in a program that provides an excellent support structure for the students, through common courses, seminars, and social events. For example, the students could take a common introductory course to lay the foundation for the student and faculty interactions and they could continue to interact in a “research in progress” course where they each rotate the presentation amongst themselves. In this way they form their own cohort while still utilizing the robust resources of the two departments. However, the current structure relies solely on the Program Director and the Department of Chemistry committees.

5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

The faculty from the proposed program outlined the increased need for biochemists in the proposal, succinctly and accurately. Other programs have seen this increased interest in both graduate and undergraduate degrees in biochemistry.

II. Faculty

6. **Evaluate the faculty**, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

The faculty of the Departments of Chemistry and Biology that will participate in this program are excellent. Their funding rate exceeds the national average and their publication record is impressive. Perhaps more importantly when starting a new program, they are all enthusiastic about the new program because they feel it will benefit the students by giving them the correct skills and recognition for their future employment. As educators, the students should always be at the center of our decisions and these faculty put the students first. At the scholarly level, the Department of Chemistry faculty currently hold 9 NIH grants and the Department of Biology faculty currently hold 3 NIH grants. This is a significant amount of funding in this climate and much of this NIH success is recent because the faculty are relatively young and have recently been able to obtain NIH funding. Without incoming students trained in this area it will be difficult to maintain the current productivity and funding level in this climate. This particular group of faculty is also noteworthy because they have been able to harmoniously work together on both this proposal and improving their undergraduate biochemistry program, which is also a joint effort, where in the past these efforts failed. Therefore, as a whole and individually these faculty are successful in scholarship, in service and in the classroom while holding the students at the center of their decision-making process.

7. **Assess the faculty in terms of number and qualifications and plans for future staffing.** Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate **faculty activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them**.

The faculty in the proposed program number 17 and are well-qualified in the area of biochemistry or related fields. They currently reside in Departments of Chemistry and Biology, respectively, and will continue to do so. The original proposal relies on courses that they currently teach, except one, due to staffing restraints. However, starting a new program is an excellent opportunity to look forward to design a curriculum that meets the needs specifically of biochemistry students and the NIH recommendations. In order to do this, two faculty hires would be needed. The program projects to increase enrollment by five students per year but the number of students who could be classified as “biochemistry students” is already in the range of 20-30 students. These students deserve an appropriate education that addresses the needs of their field. Required courses in the fundamentals would give everyone an equal starting point in the program, as well as a technique-based course, were classes that the faculty expressed a desire to teach but no resources with which to accomplish the task. Also, the reviewers felt that the faculty were lacking in the area of a microscopy expert. This is an area that would be beneficial for a complete biochemistry program.

8. Evaluate credentials and involvement of **adjunct faculty and support personnel**.

There will be no adjunct faculty involved in the program. There were no support personnel requested in the proposal. However, any current core facility managers, such as in the health core facility, will be utilized. These managers are already hired and well-qualified.

III. Students

9. Comment on the **student population the program seeks to serve**, and assess plans and projections for student recruitment and enrollment.

The program seeks to address the needs of the growing number of biochemistry students at Binghamton and in the US. While, the faculty would like to serve the undergraduate students at Binghamton, the reviewers believe this is only the target audience for the MS program but not the target audience for the PhD. Program. For example, students graduating from Binghamton with a BS in Biochemistry should be encouraged to go to the best possible school they can gain entrance because it is best for their career. It is also an excellent marketing tool, in the long term, for Binghamton because their reputation will improve with an increasing alumni population at other schools. The marketing budget and plan is small in the proposal. This will be the key to the growth of the program. The Program Director/ program committee should work with public affairs to develop a marketing plan for an on-line presence, Google searching strategy, and in-person recruiting at conferences such as the spring National ACS meeting. Additionally, long-term strategies such as hosting an NSF REU site, will publicize the fact that the Department now has this program. Once the students are aware of the program, the new building, facilities, and fantastic faculty, the program will be able to effectively recruit.

However, the MS program should target students from Binghamton. Many MS programs recruit heavily from their own student population or local industry. This degree benefits the students by increasing their employment opportunities or ability to attend medical school.

The proposal targets up to five *additional* students and given the funding, facilities and faculty, this target is very reasonable. In fact, the program will most likely exceed that very quickly.

10. What are the prospects that recruitment efforts and admissions criteria will supply a sufficient pool of highly qualified applicants and enrollees?

As stated in the answer to question 9, in order to have a sufficient recruitment pool a significant effort will have to be placed into marketing the program. Advertising the new program will require a multi-pronged approach of both short-term, long-term, on-line and in-person strategies. However, once this is achieved, a well-qualified pool of applicants can be attained.

11. Comment on provisions for encouraging participation of persons from underrepresented groups. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

The proposal indicates that the program will try to recruit students from underrepresented groups. The Department already has a program with Nigeria from which they are able to recruit excellent students. The new marketing campaign that they will develop with Public Affairs should include underrepresented students by recruiting at NoBCChE, SACNAS and through LSAMP and HBCU contacts that the faculty may have personally. The geographic region may hinder recruiting efforts since many of the students are from the region. However, the Department already makes and will continue to make significant efforts in this area.

12. Assess the system for monitoring students' progress and performance and for advising students regarding academic and career matters.

The proposal lists the examinations and courses in which the students will be assessed. In speaking to the faculty they seem to understand when these exams occur. However, the milestones should be clearly laid out for the students. Also, will all students be meeting the same milestones or will students with chemistry advisors meet chemistry milestones and students with biology advisors meet biology milestones. It is my understanding they will meet the chemistry milestones but this is a topic for the Biochemistry Program Committee to discuss. Also, the Department of Biology uses a PhD Development plan for advising students, which may be a good tool for the program to adapt. The reviewer highly encourages the Program to continue the practice of using dissertation committees as advisory committees by forming them early, in the first year, if possible.

13. Discuss prospects for graduates' post-completion success, whether employment, job advancement, future study, or other outcomes related to the program's goals.

The graduates from the program have excellent job and career prospects. These students will be able to obtain higher paying jobs, more easily with either a Masters or PhD degree in biochemistry. Careers in industry and academia will be open to students with both degrees. With the new "biochemistry" designation on their diploma and with the correct curriculum, these students will be easily recognized as well-qualified for job from research and development in large companies to group leaders in government entities.

IV. Resources

14. Comment on the adequacy of physical resources and facilities, e.g., library, computer, and laboratory facilities; practica and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

The physical resources at the University are excellent. They would entice any faculty or student to attend the University. The new building that the Department of Chemistry and the involved biology faculty occupy is well-designed, flexible and well-equipped. The labs are well-designed for biochemistry with tissue culture for mammalian and bacterial cell culture, cold rooms, synthesis, and brand-new relevant instrumentation such as CD, fluorescence and UV-vis spectroscopy. Core facilities house microscopes and other necessary biochemical equipment that is overseen by staff. The support staff allows the faculty to concentrate on research rather than instrument support. The faculty feel and are well-supported in physical resources by the administration including the Chairs, Dean, and Provost. The only resource the faculty are lacking is qualified students which is the point of starting the specialized program. Without the students, the new building, facilities, equipment and grants will be underutilized.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

Currently the proposed program is budget neutral. The faculty will utilize existing budget lines for faculty and current faculty to create a program faculty. The proposal asks for \$1000 in marketing and potentially two faculty lines if the program is successful. Based on the number of students who could potentially be considered biochemistry students currently, approximately 20-30, the budget request should be expanded. The reviewers discussed the situation and agreed that the Program should be allotted 2 new faculty hires in years 2 and 3 (1 each), one of whom should be a microscopist (ie superfast fluorescence, etc). Additionally, the Program should have a budget to host seminars such as the series they are hosting this academic year. An annual budget for equipment maintenance/purchase and marketing. These items, other than the salary lines, may total only up to \$40,000 per year but would be critical for success of the program.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

The proposed program, "Biochemistry and Chemical Biology", offers an important opportunity for successful faculty to work together to provide an education and research opportunities that meets a growing demand on the SUNY Binghamton campus and in the scientific community. The talented faculty that are proposing the program are housed in the Departments of Chemistry and Biology, respectively. Many of them have recently received NIH or NSF funding and have growing and talented research groups.

There are several strengths in the proposal. First, this program will allow the faculty to recruit appropriate students to their research group. This increases productivity, visibility of the program and university, and funding within the program. Without properly trained candidate students, the burden falls on the faculty to train students with weak backgrounds, productivity falls, it is difficult to renew grants and faculty satisfaction and potentially retention falls with the productivity. Second, the students currently in these Departments and future students will receive degrees that appropriately recognize their expertise based on their research and curriculum. Third, this program will provide recognition for the SUNY Binghamton campus. The faculty involved are individually successful and working together, they will find increased synergistic projects and most likely increased funding and productivity. This program builds on the

success that the Chemistry and Biology Departments have had in making the undergraduate biochemistry program function. Finally, not many resources will be required to start this successful program.

The proposal for this potentially strong program is missing several components that can be easily addressed. First, the program lacks structure. It relies entirely on the Department of Chemistry and the Director of the program. However, if this is to be a joint program, there should be a joint program committee that includes chemistry and biology faculty who make admission and curriculum decisions. Second, this is an excellent opportunity to develop an “ideal” biochemistry curriculum that addresses NIH training requirements and the skills and fundamentals that the faculty would like to see addressed through courses. Also, the faculty appear to agree on milestones, they are not written into the proposal. The program committee could help decide on these milestones. The faculty should carefully consider the resources needed to make this an excellent program. While one does not want to overestimate the needs, you want to give every program the best chance for success. A budget of their own is also necessary so that they are not reliant on the Departments for all of their budgeting needs. If faculty see “too many” resources being directed to the program, this can lead to dissatisfaction with other faculty in these Departments who are not part of the program. Finally, the program proposal does not address student life or cohort building. Student satisfaction can be critical to program success. This can be done through academic and non-academic routes such as required courses, seminar programs, socials, student seminars and poster sessions. These types of interactions can lead to increased collaborations between groups, productivity and student and faculty satisfaction. The above weaknesses apply to the PhD proposal. However, the proposal largely ignores the MS degree. The details and requirements of admission and the degree need to be addressed clearly.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

A biochemistry program, given the proper support, could become prominent in the region and nation based on their current faculty and funding levels. The funding levels for the faculty in the proposed program exceeds that of the funding levels for proposals. Therefore, it seems reasonable that the research produced by the faculty, and the program, is significant and will lead the new program to prominence at a regional and eventually national level.

18. Include any **further observations** important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

Several recommendations have been included in the text above. These include:

- a. The faculty should discuss and design a forward-looking biochemistry curriculum to meet the needs of the students for the next 10 years.
- b. Specific milestones should be included for the graduate students
- c. A more independent structure from the Department of Chemistry which includes a Biochemistry Program Committee which will address admissions, curriculum and policy issues is desirable. The committee should include chemists and biologists.
- d. A revamped proposal budget which accounts for short and long term needs.
- e. A detailed marketing plan which will attract appropriately trained students to the program is essential.
- f. A more detailed plan for the Masters program is required because it is not discussed in detail in the proposal.

- g. Student life, support and advisement should be considered as part of the proposal.

Overall, this proposal is strong because the constituent faculty have strong ,funded research programs, the facilities are world-class, and the program was solely designed to support the students. The latter point is the most important. The purpose of the University is to educate students and this program was designed to meet the needs of a growing number of students in the US who are focused on biochemical education and careers. SUNY Binghamton could position themselves to effectively meet their needs with their world-class faculty and facilities.



External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:

SUNY Binghamton Graduate School

(Name of Institution or Applicant)

The application is for (circle A or B below)

- A) New Degree Authority
- B) Registration of a new academic program by an existing institution of higher education:

Biochemistry and Chemical Biology

(Title of Proposed Program)

I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;
2. am not a spouse, parent, child, or sibling of any of the individuals listed above;
3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?
4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

Ellen S. Gawalt

Signature:

Handwritten signature of Ellen S. Gawalt in cursive script, positioned between two horizontal lines.

The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: Binghamton University

Evaluator Name (Please print.): Arne Gericke

Evaluator Title and Institution: John C. Metzger Professor and Head of the Department of Chemistry and Biochemistry; Worcester Polytechnic Institute

Evaluator Signature:



Proposed Program Title: Biochemistry and Chemical Biology

Degree: M.A., M.S., Ph.D.

Date of evaluation: 9/30/19 and 10/1/19

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation**. Address the program's academic rigor and intellectual coherence.

- Purpose: Establish an interdisciplinary graduate program in Biochemistry.
 - Graduating students will have a degree that is more in line with their educational background.
 - UG students with a biochemistry degree are more attracted to a biochemistry graduate degree program than a chemistry degree program. In particular the chemistry program currently struggles to attract students that are trained in basic biochemistry. It is the expectation that the new pool of students will be able to conduct research at a higher level, which will improve the quality of the research output and shorten the time to degree completion
 - The satisfaction of the faculty with the quality of the students will increase, which should lead to improved faculty satisfaction and retention.
- Organizational Structure:

- The program is shared between the chemistry and biology departments
- The program director is currently from chemistry; no mechanism how the PD is selected is spelled out
 - As the program matures and the Biology department has more members in the program, it is suggested that the directorship rotates as it is for the UG program.
- A steering committee needs to be established (curricular decisions, membership to program)
- Faculty membership in the program criteria need to be developed – who votes, what are the criteria etc. This will be important as other faculty seek to join the program
- Curricular Structure
 - Currently only one new course is proposed; this seems to be a missed opportunity. At a minimum courses that cover material required for NIH/NSF training grants (scientific conduct, ethics, career development, mentoring etc.) should be added
 - Several members voiced the desires to add courses that cover important aspects of modern biochemistry research. In the initial proposal the addition of new courses was avoided in order to develop a program that is cost neutral. Due to recent changes in the delivery of UG courses biochemistry faculty have time available => new courses can be added. The university should consider adding new faculty lines in a way that knowledge gaps in the faculty are being closed.
 - The program has no required courses; having a required Advanced Biochemistry course at the beginning of the program might help with filling some knowledge gaps and equalize the knowledge of the students at a high level.
- Requirements
 - Admission requirements
 - TOEFL 90. This score is a low requirement in comparison to other Biochemistry programs.
 - GPA 3.0 university/program 3.4 – 3.5 average applicant; quant GRE top 50 percentile. This is an adequate requirement.
 - Graduation requirements
 - The degree requirements are in line with those established in the chemistry department.
 - The program needs to spell out more clearly the path of the students through the program; while all typical elements seem to be there, a table should be added that identifies which examinations have to be taken at which time points.
 - Since the graduation requirements are developed based upon the chemistry program, it needs to be made sure that they are also in sync with the biology requirements.
- Administration
 - The inaugural director will be a faculty member from chemistry; it is not clearly defined how the director will be chosen in the future. Is the directorship term limited?
 - The program needs to establish a steering committee to run the day to day business of the program (e.g., curricular issues)
 - Membership in the program needs to be defined.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

The program is focused on Biochemistry and Biological Chemistry. The job placement prospects for graduates in this area are excellent.

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

- The program will be assessed annually following procedures established for the chemistry graduate program (performance in core credit courses, placement exams, results from examinations)
- Periodic external evaluation is not mentioned, however, in the exit interview it was mentioned that external evaluations will happen. This should be added to the document.

- Faculty satisfaction surveys is not mentioned
- Overall, the assessment/improvement plan is satisfactory.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.
- The program is an interdisciplinary program between the Biology and Chemistry departments. This is appropriate for a biochemistry program.
 - Strong synergistic effects between this newly created program and the programs in the College of Nursing and Health Sciences as well as the Brain and Body Imaging Center can be expected.
5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

There is currently a strong need for Masters and PhD level students with a background in Biochemistry/Chemical Biology. In particular, startup companies in the Biotech sector have significant needs for highly qualified graduates in this area. The desire of NY state to attract more Biotech companies/startups to this geographical area of the state will be supported with the creation of this program. In addition to providing the biotech industry with graduates, it also communicates the desire of the state to support and promote this area of research.

II. Faculty

6. **Evaluate the faculty**, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

The participating faculty have excellent publication records. Several of them are recognized as leaders in their respected fields. The faculty will be able to provide graduate students with an environment that is excellent for high quality education and research.

7. **Assess the faculty in terms of number and qualifications and plans for future staffing.** Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate **faculty activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them.**

The participating faculty have been very successful in attracting significant funding for their research. The level of funding is more than sufficient to provide graduate students with an excellent research environment. Faculty have also been successful in attracting funds for research instrumentation. There are no critical gaps. However, failure to implement this program may lead to a loss in the quality of the graduate students and as a result, less competitive grant proposals.

8. Evaluate credentials and involvement of **adjunct faculty** and **support personnel.**

There are no adjunct faculty involved. The program is supported by staff from the Chemistry and Biology departments.

III. Students

9. Comment on the **student population the program seeks to serve**, and assess plans and projections for student recruitment and enrollment.

The Biochemistry/Biological Chemistry degree is one of the most popular degrees in the Life Sciences. Bachelor programs in Biochemistry are typically larger than the chemistry programs at the same institution and these BS students are ideal candidates for the program. Upon starting in the program, the students will already be well trained in biochemistry and they should be able to handle the rigor of the classroom work and make an immediate impact on the research programs of the participating faculty. *If this program was not implemented, it would be less likely that high achieving students with a BS degree in biochemistry would choose SUNY Binghamton for their graduate studies.*

10. What are the prospects that recruitment efforts and admissions criteria will supply a **sufficient pool of highly qualified applicants and enrollees**?

There is a sufficiently large pool of qualified students with a BS degree in Biology, Biochemistry or Chemistry who would be well suited for this program.

11. Comment on provisions for encouraging participation of **persons from underrepresented groups**. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

The participating departments and faculty have an excellent track record with respect to the inclusion of students underrepresented in the sciences, including ethnic minorities. If the program finds that a significant number of part-time students is interested in the program, the program should adjust its course offerings to times later in the afternoon/early evening and/or hybrid classes with an online component.

12. Assess the system for monitoring **students' progress and performance** and for **advising students** regarding academic and career matters.

Student progress will be monitored using programmatic milestones like course, candidacy examination and meeting with the advising committee. The program description is "light" on details about advising and career development programming – this part should be expanded upon.

13. Discuss prospects for graduates' post-completion success, whether **employment, job advancement, future study, or other outcomes related to the program's goals**.

Considering the likely strength of the program and large number of available jobs in this scientific area, the job prospects for the graduates are excellent.

IV. Resources

14. Comment on the adequacy of physical **resources and facilities**, e.g., library, computer, and laboratory facilities; practica and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

The Biology and Chemistry Departments are housed in a new science building and the laboratory space as well as the availability of low- and high-end instrumentation is excellent. The library resources are adequate.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

The institution is committed to make this program a success. The program leadership should request additional faculty lines to address gaps in the portfolio of faculty expertise. The program will be supported with staff from the chemistry and biology departments, respectively.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

Strengths:

- The scientific focus of the graduate program is an area with excellent job prospects for the graduates and significant needs for the State of NY.
- Outstanding faculty with excellent publication and funding records
- Departmental leadership in both participating departments committed to the success of the program.
- In general, the curriculum is at a high level.
- The participating faculty are housed in excellent facilities

Weaknesses:

- Only little attention has been paid to the potential development of a professional Master alongside the thesis-based Master's program. This is a missed opportunity.
- The program should develop more new courses, in particular, in areas relevant to NIH and NSF training grants.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

The faculty participating in the program represent a unique mix of expertise. Considering the academic and research strengths of the faculty, it is highly likely that this program will have a national impact as it matures.

18. Include any **further observations** important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

n/a



External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:

Suny Binghamton

(Name of Institution or Applicant)

The application is for (circle A **or** B below)

~~A) New Degree Authority~~

B) Registration of a new academic program by an existing institution of higher education:

MA, MS & PhD in Biochemistry and Chemical Biology
(Title of Proposed Program)

I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;
2. am not a spouse, parent, child, or sibling of any of the individuals listed above;
3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?
4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

Dr. Arne Gericke

Signature:



APPENDIX F

Institutional response to the external reviewers' reports.

We would like to thank both reviewers for the time commitment, visiting Binghamton campus and evaluating our proposed program, as well as the many helpful and constructive comments, aimed at improving the final proposal. Below, please find our detailed response to the reviewers' comments, point-by-point.

Dr. Gawalt's comments

a. *"The faculty should discuss and design a forward-looking biochemistry curriculum to meet the needs of the students for the next 10 years."*

We agree that a modern curriculum will be important for the new Biochemistry and Chemical Biology Program. The main changes from our original proposal are the inclusion of a 4 credit **Advanced Biochemistry** course, as well as a new 4-credit **Contemporary Methods in Biochemistry and Chemical Biology** course. Both courses will be a requirement for all students in the program, Ph.D., M.S. and M.A. tracks. These courses will be taken in the first semester upon arrival of students in Binghamton.

A sample curriculum is shown in the table below. The required 24 credit hours would be completed in the first 1 1/2 years, leaving ample time for research starting in the second year. In particular, it is expected that students will be course complete at the end of the third semester. Such a curriculum is not vastly different from those offered by competing institutions in the Northeast (Syracuse <http://sb3.syr.edu/curriculumprogram.html>, Stony Brook <http://www.stonybrook.edu/bsb/prospective/courses.html>, and Buffalo, http://medicine.buffalo.edu/biochemistry/education/phd/course_descriptions.html). In our proposed program, all other topics would be covered by special topic courses, however, it is expected that many students will take courses like Advanced Molecular Biology and Advanced Cell Biology in the first two semesters.

Sample Curriculum

Biochemistry and Chemical Biology, Ph.D. track

Fall semester, first year Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr Methods in Biochem. Chemical Biology, (new course), required 4cr Colloquium, required (CHEM 593) 1cr Independent Study 3cr	Spring semester, first year Advanced Molecular Biology (BIOL513) 4cr Advanced Cell Biology (BIOL 514) 4cr Graduate Seminar, required (CHEM 592) 2cr Colloquium, required (CHEM 593) 1cr Independent Study 1cr
Fall semester, second year Special Topics Course (elective) 4cr Special Topics Course (elective) 4cr Independent Study 1cr	Spring semester, second year Thesis Research 9cr
Fall semester, third year Thesis Research 9cr	Spring semester, third year Thesis Research 9cr
Fall semester, fourth year Thesis Research 1cr	Spring semester, fourth year Thesis Research 1cr

Training in responsible conduct of research and ethics. Binghamton University provides training for responsible conduct in research (RCR), through face-to-face, as well as online. The procedures for training are detailed in the following link: <https://www.binghamton.edu/research/compliance/responsibleconductofresearch.html>

Participation in annual online training through the CITI system, including RCR and EH&S safety training will be required for all students entering the program. In addition, training will be provided in animal use and human subjects, should the individual research projects involve these subjects.

Furthermore, training in RCR will be incorporated into the graduate seminar CHEM 592, which students take in their second semester at Binghamton University (see course sequence above).

b. *"Specific milestones should be included for the graduate students"*

The degree requirements and milestones for the Ph.D. track are listed below. They are listed separately for the Master's tracks (see answers to comment f.).

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Attaining course complete (CC) status, i.e. completion of six 4-credit courses, graduate seminar and two semesters of colloquium. CC status should be attained latest after the 4th semester.
- 3) Passing the literature review exam. The literature review consists of a project of the student's own choosing (cannot be the same as their research project), for which a literature search has to be performed, followed by a submission of a written report and a committee-based oral examination. This exam should be completed in the 3rd semester.
- 4) Passing of the preliminary oral examination and reaching all but dissertation (ABD) status. At this stage, the students will assemble their dissertation committee (total of four tenure-track faculty committee members, three of which have to be from Chemistry/Biological Sciences Departments). The oral examination will include a 25-minute research presentation to the committee (public invited), followed by a non-public discussion with the committee. The committee will provide written feedback to the students after the examination. ABD status will be attained by submitting a written prospectus of planned research.
- 5) Completion of a minimum of one progress report. The progress report is typically given one year after attaining ABD status to the dissertation committee.
- 6) Completion of original research in a specialized area of Biochemistry and Chemical Biology, including conference presentations and publications.
- 7) Submission of a written dissertation and an oral defense of the dissertation.

c. *"A more independent structure from the Department of Chemistry which includes a Biochemistry Program Committee which will address admissions, curriculum and policy issues is desirable.*

The committee should include chemists and biologists."

This comment refers to the administrative structure of the program, which was not outlined in detail in the original proposal. Questions about the administrative structure were also raised by Professor Gericke (see below). To address these questions, the planned administrative structure is described in the paragraphs below.

It is planned that the program is administered by a steering committee, chaired by a program director, and composed of members from Biological Sciences and Chemistry Departments. Details of the steering committee and other administrative support are described in the following paragraphs.

Steering Committee. At the time of the establishment of the new program, an inaugural steering committee will be established, similar in membership to the steering committee of the existing Biochemistry undergraduate program

(Susan Bane, Brian Callahan, Christof Grewer, Sozanne Solmaz (Chemistry), Laura Musselman, Jeffrey Schertzer (Biological Sciences). The steering committee, analogous to the graduate program committees (GPCs) in regular departments, will be responsible for making decisions on regular program activities, such as 1) administering examinations, 2) student advising before a faculty mentor is chosen, 3) monitoring student's progress towards degree, 4) advising of students with respect to their academic status, 5) handling of student petitions, exceptions and course waivers, 6) making decisions on graduate student awards, 7) discussing curriculum issues, and 8) making policy decisions. The steering committee is expected to meet at least every other month during the academic year, or monthly, if need arises. Admissions will also be handled by the steering committee, in close collaboration with the graduate admissions committees from both Biological Sciences and Chemistry Departments.

Membership. Future membership of the steering committee will be determined by the chairs of the Biological Sciences and Chemistry Departments, in collaboration with the steering committee. Membership in the program will be determined based on the rules for courtesy titles, as specified in the Binghamton University faculty handbook (<https://www.binghamton.edu/academics/provost/faculty-staff-handbook/handbook-iv.html#A9>). In brief, the steering committee will review applications with resumes for prospective members of the program, who will receive membership based on qualifications for three year time periods.

Program Director. The coordination of the program will be the responsibility of a program director. The program director should also serve as the chair of the steering committee. According to Binghamton University policy, the program director is elected by the steering committee and serves at the discretion of the Harpur College Dean for time periods of three years. It is expected that the inaugural program director will be from the Chemistry Department. However, in order to keep both Chemistry and Biological Sciences departments engaged, it is expected that the director position is filled in the future by a member from each department in rotating fashion. For example, a Chemistry faculty member would be director for three years, followed by a faculty member from Biological Sciences.

Administrative Support. At the start of the new program, it is planned to utilize the administrative structure of the Chemistry Department for administrative support. Specifically, Anne Hull (Instructional Support Specialist in Chemistry) will provide the necessary administrative support for the program. While no new resources for an Administrative Assistant are requested at this time, it is possible that a part-time Administrative Assistant may be required in the future, depending on the rate of growth of the program.

d. *"A revamped proposal budget which accounts for short and long term needs."*

The budget has been revised according to the suggestions of the reviewers. The revised budget is shown in table "SUNY Program Expenses" in section 5, including a budget justification. The revised budget contains:

- 1) A request of a new faculty line starting at year one. While two new faculty lines were mentioned in the review, the Chemistry Department is currently in the process of hiring one faculty member with research and teaching expertise in Biochemistry and Chemical Biology. Therefore, only one new line is requested in the revised budget.
- 2) Funding for maintenance of equipment is now included in the budget.
- 3) The recruiting budget now includes costs for advertising, beginning at a time before the start date of the new program.
- 4) Funding for the seminar series has been included.

e. *"A detailed marketing plan which will attract appropriately trained students to the program is essential."*

While planned recruiting activities were briefly described in section 2.4 c) (Admissions), those activities, together with marketing, are listed in more detail below.

For initial marketing of the new graduate program, we propose the following activities:

- 1) Establishment of a modern website that contains relevant information about the new program, such as faculty membership and research direction, admissions information, levels of stipends, tuition allowance, scholarships and other support, research infrastructure, information about the Binghamton area etc.
- 2) A flyer will be developed and distributed to relevant departments at colleges and universities in the Northeast, from which we have traditionally hired.
- 3) Faculty members will advertise the new program when giving invited talks, or when attending conferences.
- 4) Advertising efforts will be coordinated with the graduate school, as well as Harpur College of Arts and Sciences.

The following recruiting activities are planned:

- 1) GRE name buyback program.
- 2) Visiting speaker series. Here, faculty members will offer seminars at four-year colleges in the Northeast free of charge, which are combined with meetings with students to advertise opportunities at Binghamton University.
- 3) As part of the colloquium series, faculty members of four year colleges are invited to present research seminars in Binghamton, to increase awareness of graduate school opportunities among the faculty members who can advise their students about the new Binghamton University Biochemistry and Chemical Biology program.
- 4) Undergraduate research conference. Annually, we organize an undergraduate research conference, to which graduating students from the Northeast of the US are invited. This conference allows the students to present their research, but also learn about opportunities at Binghamton University.
- 5) Mini video clips of current graduate students and faculty will be generated and integrated into the program website. These video clips will provide information on graduate student successes, funding opportunities, graduate student life, and other topics.
- 6) The program will also coordinate with efforts of the graduate school to recruiting, including recruitment fairs dedicated to minority applicants, visiting colleges where minority students attend in large numbers, and my advertising the affordability of the Binghamton area in terms of cost of living.

f. *"A more detailed plan for the Masters program is required because it is not discussed in detail in the proposal."*

The Master's program consists of two tracks that will lead to M.S. and M.A. degrees. Traditionally, the M.A. degree is the course-only based, non-thesis option, whereas the M.S. degree requires the completion and defense of a Master's thesis. As non-thesis based M.S. tracks become more common in the field, such an option is evaluated at the current time, but will not be implemented immediately at the start of the new program.

The M.S. program consists of four 4-credit graduate courses, two of which are required (Advanced Biochemistry and Contemporary Methods in Biochemistry and Chemical Biology). The remaining two 4-credit courses can be chosen as electives from the course list provided in the table in section 2.3 g). The other required courses consist of the Graduate Seminar (2 credits) and two semesters of colloquium attendance (1 credit each). The overall M.S. track will require a minimum of 34 credits, with a minimum of 24 credits to fulfill the residency requirement, as to graduate school rules. The final 10 credits will be contributed by independent study and thesis research. A proposed sample sequence is shown below.

Additional training in ethics, responsible conduct of research, etc is outlined in the following three paragraphs:

Binghamton University provides training for responsible conduct in research (RCR), through face-to-face, as well as online training. The procedures for training are detailed in the following link:

<https://www.binghamton.edu/research/compliance/responsibleconductofresearch.html>

Participation in annual online training through the CITI system, including RCR and EH&S safety training will be required for all students entering the program. In addition, training will be provided in animal use and human subjects, should the individual research projects involve these subjects.

Furthermore, training in RCR will be incorporated into the graduate seminar CHEM 592, which students take in their second semester at Binghamton University.

Sample Curriculum

Biochemistry and Chemical Biology, M.S. track

Fall semester, first year Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr Methods in Biochem. Chemical Biology, (new course), required 4cr Colloquium, required (CHEM 593) 1cr Independent Study 3cr	Spring semester, first year Advanced Molecular Biology (BIOL513) 4cr Advanced Cell Biology (BIOL 514) 4cr Graduate Seminar, required (CHEM 592) 2cr Colloquium, required (CHEM 593) 1cr Independent Study 1cr
Fall semester, second year Independent Study 8cr Colloquium, required (CHEM 593) 1cr	Spring semester, second year Thesis Research 1cr

Importantly, all coursework will be completed after the first year, leaving the second year for research.

In terms of milestones, the following requirements have to be met:

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Attaining course complete (CC) status, i.e. completion of four 4-credit courses, graduate seminar and two semesters of colloquium. CC status should be attained latest after the 2nd semester.
- 3) Completion of original research in a specialized area of Biochemistry and Chemical Biology.
- 4) Submission of a written M.S. thesis and an oral defense of the thesis. The thesis defense committee consists of at least three faculty members, with at least one tenured Biochemistry and Biological Chemistry program faculty members who is not the research advisor. The committee chair will be a tenured faculty member who is not the research advisor.

The M.A. program is a non-thesis option and consists of six 4-credit graduate courses, two of which are required (Advanced Biochemistry and Contemporary Methods in Biochemistry and Chemical Biology). The remaining four 4-credit courses can be chosen as electives from the course list provided in the table in section 2.3 g). The other required courses consist of the Graduate Seminar (2 credits) and two semesters of colloquium attendance (1 credit each). The overall M.A. track will require a minimum of 30 credits, with a minimum of 24 credits to fulfill the residency requirement, as to graduate school rules.

Sample Curriculum

Biochemistry and Chemical Biology, M.A. track

<p>Fall semester, first year</p> <p>Advanced Biochemistry (Biomolecular structure and function, new course), required 4cr</p> <p>Methods in Biochem. Chemical Biology, (new course), required 4cr</p> <p>Colloquium, required (CHEM 593) 1cr</p> <p>Independent Study 3cr</p>	<p>Spring semester, first year</p> <p>Advanced Molecular Biology (BIOL513) 4cr</p> <p>Advanced Cell Biology (BIOL 514) 4cr</p> <p>Graduate Seminar, required (CHEM 592) 2cr</p> <p>Colloquium, required (CHEM 593) 1cr</p> <p>Independent Study 1cr</p>
<p>Fall semester, second year</p> <p>Special Topics Course (elective) 4cr</p> <p>Special Topics Course (elective) 4cr</p> <p>Independent Study 1cr</p>	<p>Spring semester, second year</p>

The following requirements have to be met:

- 1) Passing of placement exams upon entry into the program. The ACS Biochemistry standardized placement exam will be used for this purpose.
- 2) Completion of six 4-credit courses, graduate seminar and two semesters of colloquium.
- 3) Completion of an acceptable original research project with at least eight credits of independent study.
- 4) Public presentation of a seminar on the subject of the research project.

g. "Student life, support and advisement should be considered as part of the proposal."

We agree with the reviewer that student support and advising should be an essential component of any graduate program. Details on advising and support are described in section 2.5, Advising and Other Support Services. In addition to advising, student life will be a part of the proposed program. In this respect, it will be important to build a coherent group of students, who feel that they are part of a community. Several activities are planned to provide this feeling of belonging to the incoming students:

- 1) Prospective students first meet during a visitation weekend, usually held in the first week of March. Here, students get to know current students in the program, as well as the new students who intend to join the program. They also get to know faculty members and teaching and support staff.
- 2) Incoming students will participate in graduate student orientation events. These events are organized at the university level, as well as the program level. Here, the students receive safety training, TA training, and information about placement exams and how to join research groups.
- 3) All students in the program will take the required courses, for example the Advanced Biochemistry course, which will allow each incoming class to get to know fellow students and form a sense of community.
- 4) A Biochemistry and Chemical Biology graduate students club will be formed, allowing students to engage in extracurricular activities, for example picnics, etc. In addition, the club is expected to participate in the outreach mission of the program, organizing events at local schools to get the next generation of scientists involved through demonstration experiments etc. Our experience is that these outreach events are very well suited for team building.

Dr. Gericke's comments

- *"A steering committee needs to be established (curricular decisions, membership to program)"*
- *"Faculty membership in the program criteria need to be developed – who votes, what are the criteria etc. This will be important as other faculty seek to join the program"*
- *"Membership in the program needs to be defined."*
- *"The program needs to establish a steering committee to run the day to day business of the program (e.g., curricular issues)"*

The steering committee and membership of the program are now detailed in the answer to Dr. Gawalt's comment, c.

Steering Committee. At the time of the establishment of the new program, an inaugural steering committee will be established, similar in membership to the steering committee of the existing Biochemistry undergraduate program (Susan Bane, Brian Callahan, Christof Grewer, Sozanne Solmaz (Chemistry), Laura Musselman, Jeffrey Schertzer (Biological Sciences). The steering committee, analogous to the graduate program committees (GPCs) in regular departments, will be responsible for making decisions on regular program activities, such as 1) administering examinations, 2) student advising before a faculty mentor is chosen, 3) monitoring student's progress towards degree, 4) advising of students with respect to their academic status, 5) handling of student petitions, exceptions and course waivers, 6) making decisions on graduate student awards, 7) discussing curriculum issues, and 8) making policy decisions. The steering committee is expected to meet at least every other month during the academic year, or monthly, if need arises. Admissions will also be handled by the steering committee, in close collaboration with the graduate admissions committees from both Biological Sciences and Chemistry Departments.

Membership. Future membership of the steering committee will be determined by the chairs of the Biological Sciences and Chemistry Departments, in collaboration with the steering committee. Membership in the program will be determined based on the rules for courtesy titles, as specified in the Binghamton University faculty handbook (<https://www.binghamton.edu/academics/provost/faculty-staff-handbook/handbook-iv.html#A9>). In brief, the steering committee will review applications with resumes for prospective members of the program, who will receive membership based on qualifications for three year time periods.

- *"Currently only one new course is proposed; this seems to be a missed opportunity. At a minimum courses that cover material required for NIH/NSF training grants (scientific conduct, ethics, career development, mentoring etc.) should be added."*
- *"Several members voiced the desires to add courses that cover important aspects of modern biochemistry research. In the initial proposal the addition of new courses was avoided in order to develop a program that is cost neutral. Due to recent changes in the delivery of UG courses biochemistry faculty have time available => new courses can be added. The university should consider adding new faculty lines in a way that knowledge gaps in the faculty are being closed."*
- *"The program should develop more new courses, in particular, in areas relevant to NIH and NSF training grants."*

These three issues are related. Two new courses will be included in the revised curriculum (for more detail, see also answer to Dr. Gawalt's comments, a.). These new courses are a 4 credit **Advanced Biochemistry** course, as well as a new **Contemporary Methods in Biochemistry and Chemical Biology** course. Both courses will be required courses for all students in the program, Ph.D., M.S. and M.A. tracks. These courses will be taken in the first semester upon arrival of students in Binghamton.

A new faculty line is now requested in the revised budget (SUNY Program Expenses Table, section 5), starting at year one. While two new faculty lines were mentioned by the reviewers, the Chemistry Department is currently in the process of hiring one faculty member with research and teaching expertise in Biochemistry and Chemical Biology. Therefore, only one new line is requested in the revised budget. The new hire will assist in teaching the new Advanced Biochemistry and Techniques courses. The research area should be related to imaging/microscopy/fluorescence spectroscopy, a research direction that is currently not well represented at Binghamton University.

As to training in ethics, responsible conduct of research, etc:

Binghamton University provides training for responsible conduct in research (RCR), through face-to-face, as well as online training. The procedures for training are detailed in the following link:

<https://www.binghamton.edu/research/compliance/responsibleconductofresearch.html>

Participation in annual online training through the CITI system, including RCR and EH&S safety training will be required for all students entering the program. In addition, training will be provided in animal use and human subjects, should the individual research projects involve these subjects.

Furthermore, training in RCR will be incorporated into the graduate seminar CHEM 592, which students take in their second semester at Binghamton University (see course sequence above, answer to Dr. Gawalt's comments, a.).

○ *"The program has no required courses; having a required Advanced Biochemistry course at the beginning of the program might help with filling some knowledge gaps and equalize the knowledge of the students at a high level."*

A new "Advanced Biochemistry" course is now included in the revised proposal, including course syllabus. We also include a new, required "Contemporary Methods in Biochemistry and Chemical Biology" course. The tentative syllabi for both new courses are shown in Appendix C.

○ *"The inaugural director will be a faculty member from chemistry; it is not clearly defined how the director will be chosen in the future. Is the directorship term limited?"*

The coordination of the program will be the responsibility of a program director. The program director should also serve as the chair of the steering committee. According to Binghamton University policy, the program director is elected by the steering committee and serves at the discretion of the Harpur College Dean for time periods of three years. It is expected that the inaugural program director will be from the Chemistry Department. However, in order to keep both Chemistry and Biological Sciences departments engaged, it is expected that the director position is filled in the future by a member from each department in rotating fashion. For example, a Chemistry faculty member would be director for three years, followed by a faculty member from Biological Sciences (see also answer to Dr. Gawalt's comments, c.).

○ *"Periodic external evaluation is not mentioned, however, in the exit interview it was mentioned that external evaluations will happen. This should be added to the document."*

We agree that periodic external review of graduate programs is an essential requirement to keep programs modern and viable. Such periodic evaluations, on a schedule of every seven years, are standard procedure at Binghamton University for all academic units. The details of this review process can be found in the following document:

<https://www.binghamton.edu/academics/provost/docs/program-review-guidelines.pdf>

The Biochemistry and Chemical Biology graduate program will be reviewed on a similar seven year schedule according to the same procedures.

- *"Only little attention has been paid to the potential development of a professional Master alongside the thesis-based Master's program. This is a missed opportunity."*

The Master's program is now described in much more detail, including proposed course sequences, in the answer to Dr. Gawalt's comments, comment f. The focus remains on offering both M.S. (thesis option), and M.A. (non-thesis option) degrees. While a professional M.S., non-thesis degree may be considered in the future, it is not included in the proposal at the start of the program.