Academic Planning Self-study Update 2013:
Matching the Class Schedule and Faculty Assignments to the Educational Mission

Due Friday, October 11

The Project: Introduction and Purpose

A core mission of the Boston University College and Graduate School of Arts & Sciences is to provide the highest quality undergraduate and graduate education to our students. The curricula we design – the majors and minors, general education program, and the like – constitute the frameworks of study we design as departments and programs, a college, and a university, to structure that experience. They also constitute implied promises that we will offer the courses necessary to fulfill those academic programs in a timely way, led by faculty whose knowledge and pedagogical skills help them fulfill those promises. Boston University is a premier research and teaching university, and in all of our communications with potential students and their families, we promote the idea that our students work with a superb faculty of nationally and internationally recognized professors engaged in work at the forefront of their fields. Of course, we pursue this mission in a manner that uses our financial resources as efficiently as possible, and that represents as fair a sharing of the obligations our curriculum poses as possible among our faculty. The CAS Annual Academic Planning Self-study, launched in 2007, is designed to ensure we manage these complicated tasks well at the department, program, and College level by developing proposals for course offerings and staffing in anticipation of the next three academic years that reflect our promises and obligations as far as possible.

The Academic Planning Self-study is principally an exercise of updating the previous year’s text and amending it to reflect any changes in curriculum, curricular obligations, resources, faculty, or other things that affect planning outcomes, and extending it to cover the new third year out. At the same time, this is not simply an administrative exercise. It should reflect the best, updated judgments of your faculty about how to fulfill the educational mission of your department or program in light of changing views of the department about that mission and how to fulfill it in light of changing norms in your field, changes in your faculty composition and their interests and expertise, and in the context of departmental and College strategic plans and last year’s follow-up discussions of the Strategic Plan for the decade 2010-2020. This annual update of the unit-by-unit self-study is designed to guide every department and program, and Arts & Sciences as a whole, to bring into high relief the curricular needs and budgetary and work distribution considerations that should guide preparation of your proposed 2012/2013 Class Schedule and FY13 Budget Requests.

All CAS units with academic programs are responsible for completing the annual Academic Planning Self-study. Even if someone other than the Chair/Director completes the forms, the Chair/Director of the unit is responsible for ensuring the report is accurate and complete and must sign off. The Self-Study should be submitted electronically with the Class Schedule and Budget Requests by Friday, October 12, to Nancy Geourntas, Assistant to the Dean (casdean@bu.edu). Please do not submit materials, or copy them directly, to the Dean or any of the associate deans.

Overview of the Self-Study

Because annual proposals should be driven by curricular needs, we are providing the following template to help you assess your unit’s curricular needs in the context of the degrees and minors you offer, the obligations to
College and University curricular needs that all departments and programs share (for example, general education, the Writing Program, the Core Curriculum) and the needs of other programs your curriculum serves. The self-study invites thinking about your department’s educational mission as a complex of responsibilities, aspirations, and priorities for students’ undergraduate (general, specialized, professional, interdisciplinary, elective, co-curricular) and graduate (master’s and doctoral level) learning. The self-study asks you to specify how, over time, your department plans to fill the specific course needs that are driven by these obligations. This information will help us understand what changes would help us provide academic programs of the quality to which we aspire, what resources are needed, and where they should be placed. This exercise will require careful consultation and discussion at the departmental level.

The self-study has four basic questions at its core:

1. What are the degree programs and requirements for which your department takes sole or shared major responsibility?
2. In what ways should your department contribute to curricular needs created by College and University programs (e.g. the Core, the Writing Program, University Honors College, general education) or those generated by the curricula of other schools, departments, and programs?
3. What courses, as a function of those requirements and needs, must be taught, and with what frequency, to ensure that the full range of students you serve can both adequately explore options and make timely progress to their degrees but also to ensure we are not devoting resources unnecessarily to running courses with little demand?
4. How, going forward, will your department develop a sustainable plan for covering those essential courses that equitably and effectively deploys your full complement of faculty?

You will notice that this self-study is designed to capture the same basic information for all CAS/GRS departments and programs, while acknowledging that each department brings a distinctive mix of instructional responsibilities and resources to our common task of balancing diverse curricular needs. This form is constructed as a common template. Adapt it to the purpose of providing the information you and we need to fulfill the purposes of the exercise at both the department/program and College levels.

The annual update of this study will, in most cases, necessitate department-wide discussion of curriculum and the distribution of teaching duties. All members of your faculty should be encouraged to participate. At the same time, unless your department or program has undergone dramatic curricular change in the past year or has experienced substantial turnover in faculty, updating the basic study should not be arduous. The main task is to update the text where necessary; update the three-year plan in Step III; and in Step IV list the major changes to the text made this year.

Specific instructions follow. Please feel free to ask questions as you go through this exercise.
STEP I. THE CURRICULAR CONTEXT
Throughout this self-study, please add any explanatory notes that help us to understand the situation.

A. Degrees and Minors offered by your program, individually or jointly

1. List all undergraduate and graduate degrees offered by your program (i.e. BA majors, Master’s degrees, doctoral degrees) and all joint degrees for which your program is responsible.

BA in Physics
[Astronomy and Physics, as well as Philosophy and Physics are BA majors officially administered by Astronomy and Philosophy, respectively, but we also keep track of the students and assign physics advisors.]

MA in Physics
PhD in Physics

PhD in Cellular Biophysics – offered in conjunction with the Department of Physiology and Biophysics

2. List all undergraduate minors offered by your program.

Minor in Physics

B. Undergraduate majors offered by other departments and programs that depend on coursework in your program

1. Undergraduate Majors in CAS: Using the listing of BA programs at http://www.bu.edu/academics/cas/programs/ to ensure completeness, list all CAS majors other than those administered individually or jointly in your department whose requirements (as spelled out in departmental sections of the bulletin) mean that students in those programs need to take coursework in your department.

Astronomy – PY211, 212 or PY251, 252; PY 313 or PY351; Electives: PY355, 405, 406, 408, 410, 451, 452
Biochemistry and Molecular Biology – PY105, 106 or PY211, 212 or PY241, 242
Biology – PY105, 106 or PY211, 212 or PY241, 242 or PY211, 106
Biology (Behavioral Biology Specialization) – PY105, 106 or PY211, 212 or PY241, 242
Biology (Cell Biology, Molecular Biology and Genetics Specialization) – PY105, 106 or PY211, 212 or PY241, 242
Biology (Ecology and Conservation Biology Specialization) – same as Biology
Biology (Neurobiology Specialization) – same as Biology
Biology (Quantitative Biology Specialization) – PY241, 242 (recommended) or PY211, 212 or PY251, 252
Chemistry – PY 211, 212 or PY241, 242 or PY251, 252
Chemistry (Biochemistry) – PY 211, 212 or PY241, 242 or PY251, 252
Chemistry (Teaching) – PY 211, 212 or PY241, 242 or PY251, 252
Earth Sciences – PY211, 212 or PY251, 252
Environmental Earth Sciences – PY211, 212 or PY251, 252
Environmental Science – PY211 or PY241 or PY251; PY212 or PY242 or PY252 encouraged
Environmental Analysis and Policy – PY105
Geography (Physical Geography Specialization) – PY211, 212 or PY241, 242 or PY251, 252
Geophysics and Planetary Sciences – PY211, 212 or PY251, 252; PY355; PY405 or PY408; Electives: PY 313 or PY351, PY405 or 408 if not already taken, PY410
Marine Science – PY211
Mathematics and Mathematical Education – Optional requirement: PY211
Neuroscience – PY105, 106, or PY 211, 212, or PY 241, 242, or PY 251, 252
Seven-Year Liberal Arts/Medical Education Program (SMED) – PY241, 242
Seven-Year Liberal Arts/Dental Education Program (SDED) – PY105, 106
2. Undergraduate majors and degrees outside CAS: Using the list of BU Schools and Colleges at [http://www.bu.edu/academics/](http://www.bu.edu/academics/) to ensure completeness, list all non-CAS undergraduate degree programs whose requirements include coursework in your department.

**ENG**

The generic ENG Natural Sciences requirement includes PY211, 212 or PY251, 252 for all ENG programs. In addition, PY313 is required in Electrical Engineering and serves as a Breadth Elective in Computer Engineering. Upper-level Physics courses serve as Professional Electives for Biomedical Engineering and as Natural Science Electives for Mechanical Engineering.

**MET**

- **Biology** – PY105, 106 or PY211, 212
- **Post-Baccalaureate Certificate in Pre-Medical Studies** – PY105, 106

**SAR**

- **Undeclared, Physical Science Sequence** – PY105, 106
- **Undeclared, Behavioral Science Sequence** – PY105 (optional), + eventual major requirements
- **Athletic Training** – PY105, 106
- **Athletic Training (BS)/Physical Therapy (DPT)** – PY105, 106 (summer after Sophomore year)
- **Speech, Language, and Hearing Sciences** – “physical science requirement” – 1 semester PY100 or 103 or 105 or 231
- **Health Studies (BS)/Physical Therapy (DPT)** – PY105, 106
- **Human Physiology** – PY105, 106
- **Nutritional Science** – PY105, 106

**SED**

- **Science Education Program** – “the equivalent of at least a minor in the content field”
  - Biology Specialization – PY105, 211, or 251 and PY106, 212, or 252
  - Chemistry Specialization – PY105, 211, or 251 and PY106, 212, or 252
  - Earth Science Specialization – PY105, 211, or 251 and PY106, 212, or 252
  - General Science Specialization – PY132
  - Physics Specialization – PY211, 212, 354, 581, and 4 additional 300-level courses in Physics or Chemistry

**SMG**

Requires one Natural Science or Math and Computer Science course, and expects several other CAS electives (Level A, B, C – designation unclear)

**Division of Military Education**

“Most scholarships are awarded to those majoring in engineering or scientific disciplines.”

**Naval Science** - two semesters of calculus-based physics

3. Undergraduate minors: Using the listing of minors at [http://www.bu.edu/academics/cas/programs/](http://www.bu.edu/academics/cas/programs/), list all (CAS and other) minors whose requirements can be fulfilled by required or elective coursework in your department.

- **Engineering Science** – PY211; **Track C/Biomedical**: PY212 (as prerequisite)
- **Environmental Science** – PY211

C. Graduate programs offered by other departments and schools that depend on coursework in your program
1. GRS Master’s Programs outside your department. Using the list at http://www.bu.edu/academics/grs/programs/, list all Master’s degree programs whose requirements (as spelled out in departmental sections of the bulletin) include coursework in your department.

- Biology (elective: PY681)
- Earth Sciences (electives: PY371, 405, 406, 408 – requires petition)
- Molecular Biology, Cell Biology & Biochemistry (elective: PY771)

2. GRS Doctoral Programs. Using the list at http://www.bu.edu/academics/grs/programs/, list all doctoral programs whose requirements (as spelled out in departmental sections of the bulletin) include coursework in your department.

- Biology (elective: PY681)
- Earth Sciences (electives: PY371, 405, 406, 408 – requires petition)
- Molecular Biology, Cell Biology & Biochemistry (elective: PY771)

Certificate in Computational Science – The Center for Computational Science offers this certificate program to graduate students in engineering and science pursuing a PhD. The certificate is obtained through a multidisciplinary training program “Advanced Computation in Engineering and Science” (ACES).

3. Non-GRS Graduate Degrees. Using the list of Schools and Colleges at http://www.bu.edu/academics/, list any non-GRS graduate programs whose requirements include coursework in your department.

- ENG
  - Materials Science and Engineering (MS) – students must take two courses among a list of core courses that includes PY543 and possible concentration courses PY744 & 771. As a service to ENG, Prof. Bansil is currently teaching the core courses ENG MS504/ME504/BE504 with PY744. ENG did not have a faculty member available with the appropriate expertise.

- Mechanical Engineering (MS, PhD) – PY501

- MED
  - Cell and Molecular Biology (PhD). PhD graduate students enrolled in this program may opt to perform research with Physics faculty. For instance, during academic year 2005-06 Prof. Rama Bansil had a MCBB graduate student working in her lab. The student registered for two PY courses for his program (PY 771 Biophysics and PY 744 Polymer Physics).

D. College Requirements and Programs: Writing, Foreign Language, Math, Core Curriculum, Divisional Studies

In general, all departments and programs have responsibilities for selected aspects of the CAS curriculum that go beyond the major. Describe your department’s typical role in any of the following in which it has participated. (In what ways has your department contributed? To what extent?) For any aspect in which your department (including through individual faculty) has not played a recent role, enter “None.”

1. Core Curriculum

   The Physics Department has traditionally been an important contributor to CC105. Profs. Scott Whitaker, Rama Bansil, Karl Ludwig, and Robert Carey have all been, or currently are, participants.

2. Kilachand Honors College

   Prof. Campbell is teaching in HCS01/502 this year. Prof. Sheldon Glashow has offered KHC PY101, a writing intensive seminar on Energy for Kilachand Honors College students, in the past but is currently on sabbatical. He plans to offer it again in the 2014-2015 academic year.
3. Teaching seminars toward fulfillment of the College Writing requirement

Prof. Skocpol had been teaching a WR 150 course on the Evolution of Computers, but he is retiring after this year. The department would like to re-engage with the writing program in the future.

4. Implementation of the foreign language requirement

The Physics Department and the BU Study Abroad program continue to run their unique internship program for physics majors at the University of Geneva, and CERN. Current freshmen students who plan to participate in the Geneva program are required to take at least two semesters of French even if they have already satisfied the Language Requirement in a different language.

5. Offering Divisional Studies courses that also serve as gateways to your major(s)

All three of our calculus-based introductory sequences can satisfy our major, and also are listed for Divisional Studies (PY211, PY212, PY241, PY242, PY251, PY252)

6. Offering Divisional Studies courses that do not also count toward majors in your department or division

PY100, PY103, PY105, PY106, and PY231 are all offered most years, and are approved for Divisional Studies.

7. Offering selected courses that are not important for fulfilling requirements for your major(s) or minor(s), but are in very high demand by students because of their interests

The following physics courses satisfy the Divisional Studies requirement, but are not specifically required by any program:

PY100 – Introduction to 20th Century Physics – Prof. Sheldon Glashow
PY103 – Cinema Physica, Prof. Andrew Cohen
PY231 – The Physics of Music, Prof. Lee Roberts

Nearly all of our other introductory physics courses are in high demand from students in majors that require such courses. While we know that some students take introductory courses out of interest, we do not track their numbers.

8. Any other aspects of the CAS curriculum you want to mention

Several BUCOP students are receiving joint degrees in CFA or ENG in addition to their CAS Physics degree.

Additional Comments:

In addition to our close relationship to the Astronomy Department, embodied by the Astronomy and Physics undergraduate major, we rely upon the Mathematics Department for several prerequisite/required courses and a number of courses from their advanced undergraduate curriculum. A not insignificant number of our physics majors also either major or minor in mathematics. The most common MA courses taken by physics majors are MA 123, (124, 127, or 129), 225 (specifically required), 226, 242 or 442, and 411, 412.
STEP II. ASSESSMENT OF SPECIFIC COURSE NEEDS

In updating this assessment, you should be guided in part by past enrollment patterns and what these imply about patterns of demand over time. Consider and incorporate evidence of your program’s inability to meet student demand for specific courses or, conversely, instances of lower enrollments than you had projected and desired.

A. OBLIGATIONS TOWARD UNDERGRADUATE EDUCATION. The list of requirements generated above from curricular obligations at the department, program, College, and university levels imply an obligation to offer specific courses and course types on a regular basis. What are these obligations? Note: With this question we seek to identify the core curricular obligations each department has. Every department and program ought also to offer a wider set of courses that enrich the educational program, take advantage of faculty expertise, etc. Taking into account your department’s obligations in undergraduate education as specified in Step I above, indicate the frequency with which your faculty should offer specific courses (number and name) and course types (e.g., 2 Core sections, 2 upper-level electives in subfield X) in order to serve students well in allowing them to finish their degrees in a timely way:

1. Which courses and course types should be offered every semester?
   The introductory courses that serve a vital and timely role in the education of a wide range of budding young scientists and engineers throughout the University are offered every semester and in the summer:
   PY105, PY106
   PY211, PY212, PY313
   One caveat is that PY313 is no longer offered in the summer. Demand for this summer course fell precipitously after ENG no longer required PY313 for biomedical engineering majors.

   Recently there has been sufficient demand for PY103 (Cinema Physica) to offer this course every semester.

2. Which courses and course types should be offered annually?
   Our non-major courses that satisfy distribution requirements are typically offered annually:
   PY100, KHC PY101, PY231

   Our 2-semester sequence for seven-year medical students and other strong biologically oriented students is offered annually:
   PY241-PY242

   Our courses aimed primarily at physics majors and astronomy majors are offered annually:
   PY195
   PY251-252
   PY351-352, PY355, PY371
   PY405-406, PY408, PY410, PY421, PY451-452
   PY482
   PY543, PY551, PY571, PY581

3. Which courses and course types should be offered every other academic year or every third year?
   We do not have any courses of this type.

B. OBLIGATIONS TOWARD GRADUATE EDUCATION. Taking into account your department’s obligations in graduate education as specified in Step I above, list specific courses (number and name) and course types that
your faculty should offer in order to serve students well in allowing them to finish their degrees in a timely way. (Note: Once again, we seek to identify the core curricular obligations each department has. Every department and program ought also to offer a wider set of courses that enrich the educational program, take advantage of faculty expertise, etc.).

1. Which courses and course types should be offered every semester?  
*None, except faculty-member-specific reading or research courses, which already have different numbers for the fall and spring semesters.*

2. Which courses and course types should be offered annually?  
*Our core courses for physics graduate students are offered annually:*  
PY501, PY502, PY511-512, PY521-522, PY541, PY543, PY551, PY571, PY581, PY713-714, PY741-742  

*Our course PY961 Scholarly Methods in Physics (1 credit) is offered each Fall to the incoming graduate students.*

3. Which courses and course types should be offered every other academic year or every third year?  
*Advanced graduate courses with lower demand are typically offered every other academic year:*  
PY536, PY542, PY731, PY744, PY745, PY747, PY751-752, PY771, PY841
STEP III. PLANNING FOR EFFECTIVE, EFFICIENT, EQUITABLE, AND SUSTAINABLE COURSE STAFFING

The core of the process of developing a course roster requires starting with the course rotation needs identified in Step II of this document. Although we develop course rosters from one year to the next, the exercise really requires curricular planning over a longer time period that takes account of the shifting availability of specific faculty and other constraints.

This section of the self-study asks you to devise a plan for staffing your core course rotation needs over the upcoming three-year period. The most straightforward way to do it is to list each course (or type of course, where multiple courses could cover the requirement) and indicate how your department proposes to cover the obligation over the next three-years (2012/2013, 2013/2014, 2014/2015).

Examples:

Dean Studies 101, required every semester: Dean Sapiro will teach this every fall, and one of the associate deans will be committed to teach it on a rotational basis every spring.

Dean Studies 102, required once a year. This is a skills course for which we have a very good lecturer we would like to continue to hire to teach this course.

Dean Studies 201, required once a year: Associate Dean Thacker and Associate Dean Kaiser will alternate turns, with each taking a two-year stint.

Dean Studies 301, required once a year: At the moment we have no faculty member able to teach this, so we would like to employ one of our advanced graduate students as a Lecturer/Senior Teaching Fellow for next year. In the meantime, Associate Dean Johnson is developing this course for her repertoire.

Dean Studies contributes one faculty course to the Core Curriculum each year.

SMG requires all their best MBA students to take Dean Studies 555; Associate Dean Cooper is planning on offering this once a year.

Further notes for developing your plan:

1. The quality of the educational experience for both undergraduates and graduates is of prime concern. For undergraduates the first-year experience has a major impact on the likelihood that they will succeed and flourish through their academic experience. Wherever possible faculty should be involved in students’ academic experience of their first years at college as well as their later ones.
2. All faculty should participate in sharing the core elements of the curricular obligations of the department.
3. Faculty workloads should be distributed as equitably as possible in terms of sharing core elements of the curricular obligations of the department, class sizes, course level (introductory, advanced, graduate) and, in addition, in consideration of graduate student and undergraduate advising loads. New assistant professors should be given consideration in being able to repeat courses while developing a full repertoire of courses, and more senior faculty are not exempt from developing the ability to share in new curricular obligations.
4. Faculty should not “own” particular courses; if a new faculty member has core expertise in an area that has been taught repeatedly by someone else for many years, develop a plan for rotation.
5. Recent years’ enrollments will be useful in developing both this three-year plan and the specific roster of courses you compile in any given year. Courses that have recently enrolled very few students should be taught less often. Departments with relatively few majors should stretch to serve more College and University curricular needs.
CC105, taught every fall. The Physics department plans to continue playing a significant role in the future, with Prof. Ludwig planning to teach in the course again in Fall 2014.

KHC PY101, taught every spring by Prof. Glashow.

KHC HC501/502, taught every year. Prof. Campbell is currently teaching in this class and plans to continue into the foreseeable future.

PY100, taught every fall by Prof. Glashow.

PY103 is currently planned to be offered either once or twice a year as needed, and will be taught by Prof. Cohen (who developed the course).

PY105, taught every semester by a cadre of faculty. Master Lecturer Duffy continues to play a seminal role in the development of studio approaches, as does Prof. Goldberg. They are taking a lead in developing studio approaches at BU using the new studio classroom constructed in the basement of SCI. In the future, Profs. Tsui and Ludwig will continue to teach in the course and we also anticipate a significant infusion of new teachers.

PY106 taught every semester by a cadre of faculty. Master Lecturer Duffy continues to play a seminal role in the development of studio approaches, as does Prof. Goldberg. They are taking a lead in developing studio approaches at BU using the new studio classroom constructed in the basement of SCI. In the future, Prof. Ludwig will continue to teach in the course and we also anticipate a significant infusion of new teachers.

PY195, taught each fall. In recent years, the Chair of the Department has taught this course. The Department will be transitioning to a new Chair this January; presumably (s)he will become the teacher for the course in the fall of 2014.

PY198, to be taught in fall 2014 by Prof. Klein for the first time after a several-year hiatus. This is a non-majors course focusing on probability in the natural world. If it proves popular, we plan to offer it annually.

PY211, taught every semester by a cadre of faculty. Lecturer Jariwala will continue to play an important role in teaching the off-semester course and developing new interactive course materials.

PY212, taught every semester by a cadre of faculty. Lecturer Jariwala will continue to play an important role in teaching the off-semester course and developing new interactive course materials.

PY231, taught every year by Prof. Roberts, who has particular expertise in the area (Physics of Music). We are seeking at least one more faculty member, with interest in the subject, to rotate into this course.

PY241-242, sequence taught each year with Prof. Whitaker teaching it in AY2014-2015 for the second time.

PY251-252, sequence taught each year. Prof. Ahlen will teach PY251 in Fall 2014 and Prof. Kearns will teach PY252 in Spring 2015. In subsequent years it is anticipated that Prof. Kearns will be the primary teacher.

PY313, taught every semester by a cadre of faculty.

PY351-352, sequence taught each year. Prof. Black will be teaching PY351 for the second time next year and Prof. Schmaltz will be teaching PY352 for the first time. It is anticipated that they will be the teachers in these two courses in subsequent years.
PY355, taught every year. In the near future, Prof. Klein will continue to teach it.

PY371/671, taught every year. Prof. Sulak will be teaching it for the second time in AY 2014-2015. This course was relocated from SCI 226 to a much more appropriate space in PRB 459.

PY405-406, sequence taught each year. Prof. Butler will teach it for the second time in AY 2014-2015.

PY408, taught every fall. Prof. Rebbi is currently teaching the course and will continue in AY 2014-2015, after which he will go on sabbatical and a new teacher will take over.

PY410, taught every spring. Prof. Stanley is slated to teach the course next year for the first time. Presumably he will continue teaching it in subsequent years.

PY421, taught every spring. This course will continue to be taught by Prof. Rebbi, who developed it.

PY451-452, sequence taught each year. Prof. Pi will teach PY452 again in fall 2012 and then Prof. Polkovnikov will take over the sequence.

PY482, taught each spring. In recent years the Chair of the Department has taught this course. The Department will be transitioning to a new Chair this January; presumably (s)he will become the teacher for the course in the spring.

PY501, taught each fall. Prof. Korolev is teaching this course next year and for the next few years.

PY502, taught each fall by one of our computational faculty members, typically Profs. Rebbi or Sandvik. Prof. Rebbi is teaching other courses and Prof. Sandvik will be on sabbatical next year, so we do not anticipate that the course will be offered. It will be offered in subsequent years.

PY511-512, sequence taught each year. Prof. Lane will teach it for the third time in AY 2014-2015.

PY521-522, sequence taught each year. Prof. Erramilli will teach PY522 for the third time in fall 2014. Prof. Ahlen will then take over this course sequence.

PY536, taught alternate years by Prof. Chamon, an expert on quantum information theory.

PY541, taught each fall. Prof. Chamon is scheduled to teach this course in fall of 2014.

PY542, taught every other year depending upon demand. A statistical mechanician, such as Profs. Polkovnikov, Chamon, or Klein, typically teaches this course. It is not anticipated that it will be offered next academic year.

PY543, taught every spring. A number of faculty members have taught this in recent years. In AY 2013-2014, Prof. Tsui is scheduled to teach the course.

PY551, taught each spring by a particle physics faculty member. Recently Prof. Bose has been teaching the class and we anticipate that she will continue to do so in AY 2014-2015. In subsequent years it will transition to a new faculty member.

PY571, taught each spring in a format that appeals to both senior undergraduates and entry-level graduate students. Prof. Rothschild is currently teaching this class and it is anticipated that he will continue to teach it next year.
PY581, taught each fall. Prof. Sulak is teaching it this year and will be teaching it next year as well. This course also recently relocated from SCI 130 to a much larger space in SCI 130D.

PY713-714, typically offered every year. We anticipate that Prof. Katz will continue to teach the course.

PY731, offered every other year. It is taught by Prof. Cohen, who is an expert in General Relativity.

PY741-742, offered each year. Prof. El-Batanouny taught the course this year and will continue to teach it next year.

PY744, recently offered every year because it is taught in combination with ENG MS504/ME504/BE504. This course is current taught by Prof. Bansil.

PY747, offered as needed. Prof. Polkovnikov has recently revised the course significantly.

PY751-752, sequence offered every other year. It will not be offered next academic year. Beyond that, we anticipate Profs. Schmaltz or Lane will teach the course.

PY771, taught by a biophysicist every other year. It will be taught in Spring 2015 by Prof. Mehta. We anticipate that this course will grow in popularity as our research effort in biological physics expands.

PY841, taught every other year or every third year depending upon demand. Offered by Prof. El-Batanouny using his new book. He will continue to be the instructor when it is taught.

PY895, 896, 897, 898, to be taught every other year. These are advanced graduate seminars focusing on topics of current interest. They are an important part of graduate education for our doctoral students. Next year we plan to offer seminars on particle physics beyond the standard model (Schmaltz) and nanophysics (Mohanty).

New or Refurbished Courses: Beyond those listed above, we are currently developing the following offerings:

Physics of Food (PY1xx, to be taught every semester or every year depending on demand). Prof. Bansil is working to develop this new course, which would feature (edible) lab experiments. This course explores the physical principles that underlie many aspects of food and food preparation, such as phase transitions, polymerization, emulsification, crystallization, homogenization, etc. This course has been a great hit at Harvard and Prof. Bansil is working with Prof. Alsid in the School of Hospitality and Culinary Arts to make it a reality. Some advance investment would be necessary to make the course a reality, including equipment purchases, modest lab renovation, and faculty release time. We anticipate that such an investment will be more than offset by the educational benefits and the anticipated enrollments in such a class once it is fully developed. Our goal would be to offer this course in the 2014-2015 academic year and annually thereafter. This lab-based course is intended to fulfill the CAS natural science requirement.

Necessity and Chance (PY 198). This course has been moribund for a number of years and Prof. Klein proposes to resurrect it starting in the fall 2014. This course focuses on the use of probability theory and probabilistic methods to quantitatively understand the uncertainties inherent in the physical world. Basic concepts of probability and statistics, and their connections to physical phenomena will be introduced. Using examples as diverse as games of chance, climate and earthquake forecasting, and medical testing, notions such as independent probabilities, correlation versus causality, and the meaning, use, and interpretation of statistics will be explored. Application will include understanding risk, hazard management, and the interpretation of everyday statistical phenomena within the framework of physics-based reasoning. The course will also discuss
how to combine probabilities for composite events, how to imply probabilities from measurements, and the use and misuse of statistics. The difference between the nature of probability in the classical and quantum descriptions of physical phenomena will be explored. This course is meant for non-scientists and will require only high-school algebra as mathematical preparation. If the course garners sufficient enrollment from non-majors, it will be offered every year. This course is intended to fulfill the CAS natural science requirement.

Quantitative Systems Biology (PY/BME5xx), to be offered every year or alternate years depending on demand. The Physics Department is also working with the Biomedical Engineering Department and the Bioinformatics Program to offer a new course that will appeal to graduate students across these disciplines. The proposed offering is based on a famous course at Princeton University that is described in [Nature Reviews Molecular Cell Biology 7, 829 (2006)]. The course will be based on critical readings of original path-breaking papers in diverse areas of biology; each of these papers depends on quantitative reasoning and theory as well as experiment. Close reading and discussion of these papers allows students with backgrounds in physics, computational sciences or biology to learn essential ideas and to communicate in the languages of disciplines other than their own. This course aligns with the University-wide initiative in graduate interdisciplinary education and is part of the new Center for Synthetic Biology initiative. This course will initially be taught by Prof. Mehta and will be cross-listed in BME and the Bioinformatics Program.

Econophysics (PY538, to be taught alternate years). This advanced undergraduate/beginning graduate course on econophysics will be taught by Prof. Stanley and may be offered as soon as spring 2013 under the aegis of a PY 895 course number while official approval is being sought. Econophysics, the application of statistical methods pioneered in condensed-matter physics to understand the dynamics of economic and financial systems, is a relatively new research field that has rapidly become part of the physics research mainstream. Research papers on the subject regularly appear in the highest-level physics journals. Prof. Stanley has been a pioneer in the area. He originated the word “Econophysics” and wrote the first textbook on the subject, published by Cambridge University Press. This is a unique course aimed at a broad range of advanced undergraduate and graduate students with the appropriate mathematical background (e.g., students in Physics, Mathematics/Statistics and Economics).

Physics of Carbon-Based Materials (PY7xx, to be offered every year or alternate years depending on demand): This course, currently taught by Profs. Castro-Neto and Campbell, focuses on the physics of carbon-based electronic materials. It has become clear in the past decade that carbon in the form of buckyballs, nanotubes and, most recently, graphene has unique electronic properties that can be tuned to both yield fundamentally new physical phenomena and to develop unique new high-performance functional devices. The discovery of novel carbon-based materials is perhaps the most important development in solid-state physics since the discovery of high-temperature superconductors in the 1980’s. Prof. Castro-Neto has played a major role in advancing this burgeoning field. In collaboration with Prof. Campbell, he has developed a unique graduate course that gives students an essential foundation in this topic.

Advanced Materials Characterization (PY/MS782, to be offered every year or alternate years depending on demand). This course will be cross-listed with MSE and will be taught for the foreseeable future by Prof. Bishop. This course will discuss the characterization of the atomic and electronic structure of materials. Techniques that will be discussed include atomic structure evaluation by x-ray diffraction and electron diffraction; microstructure evaluation by transmission electron microscopy, principles of bright-field, dark-field and weak-beam imaging; principles of analytical electron microscopy; study of chemical and bonding states, Raman spectroscopy; laser-based non-destructive evaluation of mechanical properties of materials. Characterization methods for semiconductors include the study of point defects by electron paramagnetic resonance, transport properties by magnetoresistance and the Hall effect, recombination phenomena by photoluminescence and junction properties by capacitance-voltage methods.
Note on Faculty Assignments:
The large majority of our undergraduate and core graduate courses can be taught by any of our faculty members. Our general expectation is that each faculty member will typically change courses on average every three years. Year One is the challenge of a new assignment; Year Two and Three reflect improvements. Beyond that, renewal of the teaching assignment is desirable. Over several years, each faculty should also teach a range of classes from the introductory undergraduate level to the graduate level.

Our staff is sufficient to offer roughly 30 separate course offerings each semester. While one of the lecturers is assigned to two courses each semester, the standard expectation for full-time active research faculty in physics is to teach one significant course per semester. The discrepancy between the number of available instructors and the number of course offerings each semester stems from sabbaticals (typically 5 per semester), grant-funded teaching releases, startup teaching release, and various exceptional circumstances.

STEP IV: EXECUTIVE SUMMARY OF UPDATES AND TEN-YEAR PLANNING

1. UPDATES: Please list all major updates that you made to this document this year.

Studio Teaching: We continue to develop studio-based teaching approaches using the new classroom in the SCI basement. This is a pioneering effort within the University. Studio is a mode of teaching that merges components of lab, lecture, and discussion in one place, with the students working collaboratively in groups of three. It is a student-centered environment (as opposed to the instructor-centered environment in a typical lecture), in which the students spend most of their time actively engaged with course material, doing short experiments, working together on worksheets, and participating in discussions. Gains in student learning have been reported at other institutions that have adopted studio physics, such as MIT’s Project TEAL and NC State’s SCALE-UP. The new studio classroom has allowed us to expand the studio physics effort to three 81-student sections of PY105-106. These are running in parallel with two conventional lecture sections, giving us experimental groups and control groups for our study of the effectiveness of studio physics. A similar process will be run in the PY211-212 sequence, with one section taught in the studio room.

The use of the studio room for PY105-106 reduces the demand for separate lab space for the class, which had become a concern, as the course enrollment has grown in recent years. However, the studio classroom limit of 81 students is lower than can be put into a large lecture hall, so more faculty members are needed to teach the course. Our initial feedback is that students report higher post-course attitudes to the subject matter; we are currently evaluating gains in student performance. Assuming that gains reported at other institutions are also realized here, the extra teaching resources necessary for studio teaching deserve the support of the Department and College.

The studio classroom is also being used by ENG for their core class EK128 as they develop new, more interactive, pedagogical approaches. We will continue to offer time to other departments, when feasible, to allow other interested faculty to test the studio teaching approach.

New or Refurbished Course Offerings: We are working to make inroads in general education by offering courses that will better educate non-physics students about how science and technology affect their everyday lives. Such courses include the Physics of Food and the revived class on probability in the natural world. Our course offerings are also responsive to opportunities to teach students about exciting new fields and cross-disciplinary topics, often in collaboration with programs outside of the department. Examples include the new MSE/Physics course on advanced characterization of materials and a proposed new cross-listed course with BME on Quantitative Systems Biology. The new or refurbished courses that we are planning to offer include:
Physics of Food PY19x, Necessity and Chance PY198, Econophysics PY538, Quantitative Systems Biology PY/BME5xx, Physics of Carbon-Based Materials PY7xx, and Advanced Materials Characterization PY/MS782.

Physical Space Issues: Both the Advanced Lab PY 581 and the Electronics course PY 371/681 have moved into new and larger spaces. The Advanced Lab is now located in SCI 130D and has considerably more space than in the previous location. There are also several new lab setups available that were donated and commissioned by Prof. Ahlen. These enhancements have made the Advanced Lab a much more rewarding experience. The Electronics course will relocate to PRB 459 starting in the spring semester of 2014. A primary advantage of this space is that it is close to our Electronics Design Facility (EDF) on the 4th floor of PRB. This proximity will allow course students to take advantage of advanced instruments in the EDF, as well as the expertise of the EDF staff. We will also use PRB 459 both semesters: The Physics of Food will be held in this room in the fall and Electronics will be held in the spring. We are endeavoring to schedule lab-based courses so as to fully utilize our physical space.

2. GOALS AND PLANNING: With continuing reference to the three preceding sections of this Self-Study, please discuss significant changes, beyond those already documented above, that your unit is planning or that you foresee occurring over the next three years, and assess the potential impact of those changes on the scope and quality of academic programs.

A. The Curricular Context: How will your unit’s set of commitments and priorities in undergraduate and graduate education evolve (include enrollment projections in cases where you foresee a substantial change in student numbers)?

A great university is an institution where a superior teaching mission is based on an outstanding program of research. The Physics Department continues to play a leading role in university-wide interdisciplinary research and teaching efforts, such as in materials science, bioinformatics, and systems biology, where physics necessarily forms a primary ingredient. We are already seeing the first fruits of these interactions with Engineering MSE graduate students enrolling in our PY543 Solid State Physics class, Prof. Bansil’s teaching of a joint PY744/ENG MS504/ME504/BES04 course, the anticipated cross-listing of a new MSE/Physics course on advanced characterization of materials to be taught by Prof. Bishop, and a proposed new cross-listed course with BME on quantitative approaches to systems-level biology to be taught by Prof. Mehta.

One of the important aspects of the physics course offerings is that the core subjects are relatively stable over a time scale of several decades or longer. As a result, we do not envision introducing curricula on broad topics that are distinct from our current offerings. By its permanence, there is little rationale to offer ephemeral “boutique” courses. The only significant shift in our recent course offerings is the increased emphasis on biological physics, a trend that we expect to continue for the next decade.

We continue to explore and pursue new approaches to pedagogy. Over the past two decades, there have been many exciting developments in Physics Education Research (PER) that have helped drive revolutionary changes in teaching techniques. A large body of PER studies has shown that interactive teaching methods are considerably more effective than the traditional lecture format, which has been the norm for our elementary courses. Our department has adopted many of the innovations that emerged from PER. Beyond the studio development mentioned above, we continue to make use of ideas from PER to develop innovative ways of improving learning within existing lecture formats by incorporating teaching materials and techniques that better engage students’ curiosity and intellect. Department faculty and lecturers have presented the results of our efforts in adopting these innovations to a national audience at an American Association of Physics Teachers meeting in Colorado and a Physics Teacher Education Coalition (PhysTEC) meeting in Baltimore.
Physics Department LA Program: As part of the Department's focus on both enhancing the undergraduate student learning experience and developing future career paths for our majors, we have developed the Learning Assistant (LA) program considerably under the direction of Dr. Manher Jariwala, who is also an organizer of the National LA Program. The LA program supports a peer-based learning program that reflects and magnifies the benefits of the vibrant, student-centered, residential-based undergraduate education offered at BU. The Physics Department LA program has been robust in its growth, and now totals 18 LAs this semester, 10 of whom are physics majors. Unique among most LA programs nationwide, our Physics LAs are spread over our entire range of physics courses, from the upper–division courses PY405, PY408, and PY451, to the intermediate courses PY313, PY351, and PY355, and throughout all of our introductory physics sequences. This program has created a vertical learning community for physics students across the undergraduate spectrum. By virtue of their experience as students, LAs provide a unique perspective for students needing assistance; through their science education training, LAs possess the pedagogical tools to do so effectively and notably, assist in course transformation. LAs themselves also benefit by learning the subject material more thoroughly by teaching it to others. Moreover the LA program provides a low–barrier opportunity for physics students to consider careers in teaching through our PhysTEC initiative. Given our success with the Physics LA program, we support the efforts of the Biology and Chemistry departments to expand their LA programs to encompass more of their introductory courses.

Future funding of LA’s in CAS: Originally an outgrowth of the RULE program, Learning Assistants at BU are paid only $700 per semester by the College (compared to $1500, for example, at CU-Boulder). We advocate full institutional funding of this program at the rate of $1200 per semester, allowing us to meet state minimum wage standards and thus also offer this opportunity to Federal Work Study students. For the 125 LAs per year currently employed by Physics, Biology, Chemistry, and Neuroscience, this amounts to $150,000. For the 1200+ students served each semester by physics LAs, the cost of the LA program translates to $25 per student served.

List any academic programs that you are currently proposing/developing/reviewing/revise, either within your department or in collaboration with other units of the College and University.

Please take advantage of this opportunity not only to think about new initiatives and growth areas, but also to assess the costs and benefits of any degree programs or minors currently offered or staffed by your unit that enroll small numbers of students. List those programs/minors here, and in each case say why the program should be continued as is, strengthened, absorbed as a track within some larger program, or discontinued to free up teaching and advising capacity for higher priorities.

Note: The future of low-enrollment programs will be a particular focus of our follow-up discussions with you.

B. Specific Course Needs: In what significant ways will the changes listed in “A” above affect the courses (kind, size, format, offering patterns) you will need to offer?

As we gather experience with studio teaching, it is likely that PY105-106 and other large introductory courses could all come to embrace studio sections. As discussed above, we are also working to offer courses with broader appeal for general education of non-majors.

C. Course Staffing: How do you see the next ten years of turnover and renewal affecting the composition and profile of your faculty? Please think especially of how you will use replacement positions to build areas of new or continuing high priority in research and teaching. How will these changes affect your planning for the implementation of current and future curricula?
As already mentioned under “A” staffing questions are considered on a continuing basis by our faculty. Our staffing plan requires substantial revision to deal with recent and unexpected faculty losses. Moreover, we anticipate a significant number of faculty retirements in our department within the next 2-8 years because of a large cadre of senior faculty—10 are age 65 or older and 9 are between 60-64. While almost all of them maintain vibrant and well-funded research programs, it is imperative to have a plan in place, with agreed resources from the Dean and University, to rebuild our faculty in a thoughtful and timely manner from a position of strength. If managed properly, the many looming faculty retirements will provide a unique, once-in-a-generation opportunity for renewal. After consultation with the Dean, the department has begun to develop a comprehensive plan for this renewal.

Thank you for taking the time to engage in this exercise. It will help us serve our students and faculty better. We will take account of the responses in responding to specific proposals, requests for temporary lecturers, and requests for new and replacement faculty positions. We will also use the self-study as one basis for continuing discussions in the College about strategic planning.