Boston University College of Arts & Sciences

Academic Planning Self-study Update 2011:
Matching the Class Schedule and Faculty Assignments to the Educational Mission

Due Friday, October 14

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 7, to Michael Mercurio, Assistant to the Dean (mwm2@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 and 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 (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
Biochemistry (Quantitative Biology Specialization) – PY241, 242 (recommended) or PY211, 212 or PY251, 252
Biology and Cognitive & Neural Systems (BA/MA) – same as Biology
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
Neuroscience and Cognitive & Neural Systems (BA/MA) – same as Neuroscience
Seven-Year Liberal Arts/Medical Education Program (SAMED) – 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, plus an elective from the list CAS CH102, ENG BE209, CAS PY313. The full choice of electives applies to the Aerospace Engineering, Mechanical Engineering, and Manufacturing Engineering programs. Electrical Engineering specifically requires PY313, Biomedical Engineering specifically requires BE 209, and Computer Engineering requires either PY313 or BE 209.

**MET**
- **Biology** – PY105, 106 or PY211, 212
- **Post-Baccalaureate Certificate in Pre-Medical Studies** – PY105, 106
- **Science and Engineering Program** – PY211, 212; PY313 – program discontinued

**SAR**
- **Undeclared, Physical Science Sequence** – PY105, 106
- **Undeclared, Behavioral Science Sequence** – PY105, + 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 sem, PY100 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”

**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/](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)

**Cellular Biophysics** (PY410, 511, 512, 521, 522, 541, 542, 771; directed study elective: PY901, 902)

**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 which includes PY543; possible concentration courses: PY744, 771, 783

**Electrical Engineering (MS), Computer Engineering (MS), Mechanical Engineering (MS), Photonics (MS)** – may take physics courses, no details

**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

**Physics Department is an important contributor to CC105.** Professor Scott Whitaker regularly participates each Fall, although in Fall 2012 he will be on sabbatical. He lectures and teaches a discussion section. In addition, Professors Rama Bansil, Karl Ludwig, and Robert Carey have in the past participated. Future participation will be worked out based on the teaching needs of CC105, and the availability of interested Physics faculty.

2. Kilachand Honors College

**Prof. Sheldon Glashow has offered UHC PY101,** a writing intensive seminar on Energy for Kilachand Honors College students in Spring 2010 & 2011, is doing so again in 2012 and proposes to continue to do so each Spring.

**Prof. Andrew Cohen is Associate Director, and is teaching the Honors College sophomore integrative course HC301 “Inst & Invnt 1” this Fall.**
3. Teaching seminars toward fulfillment of the College Writing requirement

WR 150 Cosmology, taught by Larry Sulak, will again not be offered this spring (2012) because he is on research leave, following a sabbatical year. It is one of the few scientifically oriented WR150 offerings and has been very successful. Physics majors have no admission priority at the present time, and it has always been over subscribed. Prof. Stone, a former Jefferson Fellow at the U.S. State Department, taught WR150 based on International Science Policy Issues in Spring 2011, but is on sabbatical in 2011-2012.

4. Implementation of the foreign language requirement

The Physics Department and the BU Study Abroad program have developed an internship program for physics majors at the University of Geneva, and CERN. It was implemented on a trial basis for seven juniors during Spring 2010 and again for five juniors in Spring 2011. Current freshmen who are expecting to participate in the Geneva program will be 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. PY132, 138 and 233 have been approved for divisional studies in the past, but are not currently offered.

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. They are nearly full to capacity (PY100, PY231) or rapidly growing (PY103), demonstrating that these students have a personal interest in these courses:

PY100 – Introduction to 20th Century Physics – Professor Sheldon Glashow
PY103 – Cinema Physica, Professor Andrew Cohen (currently Assoc Dir of the UHC)
PY231 – The Physics in Music, Professor Lee Roberts

Nearly all of our other introductory courses are in high demand as well from students in majors that require introductory courses. While we know that some students take introductory courses out of interest, we don’t know how many. Prof. Roberts has applied for sabbatical next year, so PY231 will not be offered next spring.

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

There are several cross registered students and joint (BUCOP) majors, especially from the College of Engineering.

Additional Comments:

In addition to our close relationship to the Astronomy Department embodied by the Astronomy and Physics undergraduate major, we rely upon the Math Department for several prerequisite/required and many voluntary course choices. Our students also sometimes take computer courses such as CS111.

Theoretically oriented physics students often earn degrees in both Math and Physics, and it is easy for most physics students to qualify for a Minor in Math.
Our students never constitute a majority in any of the MA courses, and therefore the courses are not aimed at the specific needs of physics students who continue to intermediate- and advanced-level work. For example, MA225 - Multivariate Calculus rarely gets to vector calculus, and therefore we have to teach mathematical topics such as divergence, gradient and curl of a vector field in our PY355 Methods of Mathematical Physics. The math department is seeking to improve MA225 so that all sections cover these topics. Similarly, the computationally oriented treatment of differential equations in MA226 is interesting in itself, but does not cover the analytical methods essential in physics. We find that PY355 (offered in the spring only) is the crucial prerequisite for all our 400-level courses. If a student must delay or retake this course, their program almost certainly extends beyond four years.

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?

   Our courses sizes are limited by the instructional lab availability, which impacts how often we teach. Introductory physics courses have 3-hour lab sections that can accommodate a maximum of 22-24 students each. (12 setups per station; more than two students per setup noticeably reduces individual participation and thus the learning experience.) If labs are scheduled every day from 8 or 9 am to 9 or 9:30 pm, except for late Friday and early Monday for setup and changeover, a maximum of about 15 lab sections can be held per week (some of which are perennially difficult for both 1st and 2nd year TFs to cover). Currently, therefore, the absolute limit on the number of students that can enroll in one of our courses per semester is 360. Last year, with an increase of 100 freshpersons in ENG, we needed 18 labs in PY211 Spring 2011 which ran 9 am Monday through 5 pm Friday to accommodate the increase of enrollment.

   Both PY105-106 and PY211-212 are taken by many more students than this per-semester limit. Thus PY105, 106, 211, and 212 are offered every semester, including the summer. This also helps to reconcile the different scheduling patterns needed by different majors. For example, most engineering students are advised to start the PY211-212 sequence in the Spring, after having taken MA123 in the Fall. CAS majors tend to take 211-212 starting in the Fall. This course increased from 150 last Fall 2010 to 180 this Fall. Generally there are enough students ahead or behind the typical schedule that all courses all semesters have a mixture of students. PY313 is offered in both Fall and Spring, as a natural continuation of the 211-212 sequences. PY 313 used to be required of all ENG students, but Biomedical Engineering majors now must take ENG BE 209 instead, and only Electrical Engineers are specifically required to take PY313. Therefore low enrollments have lead to the demise of the Summer Term offering of PY313, and threaten the off-sequence Fall Term offering as well, although it has recovered to 40 last Fall and this. The Spring Term offering remains healthy.

   PY482, our Undergraduate Physics Seminar is ordinarily offered each semester. The topics rotate among particle physics, condensed matter physics, and biological physics. When taught as a showcase of local speakers, the burden on any one faculty member is low. However, if a faculty member addresses a focused set of issues such as nanophysics, and gives most of the presentations, then it represents 2 credits of effort that is hard to account for when teaching expectations are tallied. There continues to be debate in our department about the utility of this course and its long-term sustainability is uncertain. Part of the reason for this problem is that this course has recently been taught as a voluntary overload.

2. Which courses and course types should be offered annually?
A. PY195 Freshman Physics Seminar (1 cr), in the Fall, orients some of our physics freshmen to college life and opportunities at Boston University, study skills and resources, and physics beyond the textbook. This fall the size of PY251 required adding a third lab, which unintentionally overlaps the time of PY195. This will be reexamined for next year’s schedule. A PY196 Spring Term extension has been offered that is a discovery seminar consisting of a set of hands-on experiments in science and engineering content discovery. Prof. Goldberg is in charge of this.

B. PY103 Cinema Physica will be offered this Spring. Prof. Cohen who developed the course is Associate Director of the University Honors College. This year he is teaching the UHC sophomore course in the Fall, and PY103 in the Spring. Prof. Schmaltz has also expressed an interest in teaching this course in the future.

C. Our single-semester general education courses (PY100 and hopefully PY103) should continue to be offered annually. Inactive courses of this type in our approved inventory include PY132 Physics of Motion, PY138 Chance and Necessity (never very large) and PY233 Energy and Environmental Physics (formerly required of Environmental Science majors who now take the standard introductory courses). Prof. Glashow’s Freshman Seminar on Energy is now UHC PY101, and is restricted to Honors College freshmen.

D. Our more specialized calculus-based introductory courses [PY241-242 for Seven-Year Medical and Quantitative Biology students; PY251-252 for physics majors] are offered every year.

E. All other Physics Department courses taken by physics undergraduates are offered every year: PY354, 355, 371, 405, 406, 408, 410, 421, 451, 452, 543, 551, 581. PY354 Modern Physics has been modified somewhat in content and now has the number PY351. It is followed by PY352 in the spring providing additional more applications-oriented content. The question of whether PY352 will begin to be required, and for whom, has been addressed, but not resolved, at the departmental level.

F. We are very pleased that the Neuroscience Program now requires a full year of introductory physics, from our existing courses.

G. Advanced Lab, PY581, is primarily taken by undergraduates. The equipment in SCI 128 is being moved to SCI 130D, so that next year, Advanced Lab can operate within a contiguous space consisting of 132, 130D, and 130F. Prof. Ahlen is investing major effort in renewing and upgrading the available experiments.

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

The Department had suggested working toward intermediate-level (300- and 400-level) topical electives (4-credit courses) that could be offered at a rate of one per semester, thereby still being available to most physics undergraduates (and students outside of physics) over the course of their program. Possible examples include “Optics and Lasers Lab”, “Experimental Particle Physics”, “Biological Physics”, “Materials Science” and “Nanoscience”. We are woefully limited in our course selections that bridge the gap between foundational textbook knowledge and modern physics research. Our first attempt at bridging this gap has been the development of PY352 as an annual course. Also, the annual course PY771 Biophysics has been more appropriately adapted and labeled as PY571 Introduction to Biological Physics, and is therefore available to our undergraduates. One new course, PY536, Quantum Computing, operates on a two-year rotation. Prof. Chamon voluntarily taught it the second time in addition to his regular assignment in Spring 2011. In our revised 2011-2012 schedule, he will get his corresponding teaching release in Spring 2012.
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 Fall and Spring.

2. Which courses and course types should be offered annually?
   Our course PY961 Scholarly Methods in Physics (1 cr) is offered each Fall to the incoming graduate students. This year it will be offered in the Spring, because the new Director of Graduate Studies Steve Ahlen was already teaching PY581 in the Fall, and needed time to come up to speed with the many pending responsibilities of the DGS position.

   Our courses required for the MA are available for each year’s graduate student cohort. PY501, 511, 541 are Fall Term; 512, 521, and an elective such as PY543, PY551, or PY771 are Spring Term. During Fall of the second year, Advanced Lab PY581 is required of those who have not had an equivalent course or experience, and PY502, or the continuations PY522 and 542 are available to round out an 8-course requirement. We do not presently offer PY531 Classical Mechanics, but most students have had it as undergraduates, and are able to prepare for questions in that area of the Comprehensive Examination without a student taking a graduate course in the subject. Now that Biological Physics is becoming a larger sector of the department, we have adapted the present PY771 into a PY571 Spring Term elective available to both undergraduates and graduate students.

   At 700 level, enrollment has been adequate to offer PY741-742 Solid State Theory every year, except this year, when all possible teachers of it were on some form of leave, or needed for other courses.

   In principle, PY713-714 Quantum Field Theory and PY751-752 High Energy Physics should also be available for each cohort of graduate students to take as soon as possible. High Energy experimentalists want their PhD students to get their coursework out of the way as soon as possible so that they can go frequently or long-term to research sites overseas. However, High Energy theorists take on only very highly qualified graduate students, working more with postdoctoral fellows, which limits the enrollment in these courses to the point that in some years they cannot be offered. Condensed Matter students tend only to take the first semester of one of the two sequences for their distribution requirement, and there are competing options such as computational physics PY502 or PY621. As a result, recurrent enrollment issues have lead us to provide the two sequences in alternate years, typically with lower enrollment in the second semester of each sequence.

   To consolidate a Biological Physics program, based on our increased faculty in this area, and the expectation of additional faculty, there should be a new, more advanced PY771 that would follow an introductory PY571, as is currently the case with Condensed Matter in 741-742 following 543 and High Energy in 751-752 following 551. Prof. Mehta has developed this course and has submitted it for CAS NSCC approval, so that it can be offered this spring (Spring 2012).

3. Which courses and course types should be offered every other academic year or every third year? 
   As stated above PY713, 714 and PY751, 752 are offered in alternate academic years, although if enrollments were sufficient, they should be offered every year.
Enrollment issues are also operative in the decision to rotate certain courses approximately every three years. This pattern is most noticeable on the condensed matter side of the department. The courses that have been offered every few years are PY744 Polymer Physics (Bansil), PY747 Advanced Statistical Mechanics (Klein, plus Redner’s 897), PY841 Symmetry in Solid-State Physics (El-Batanouny), and usage of 895-898 seminar numbers for repeated topical lecture courses on “Condensed Matter Physics” (Ludwig), “Experimental Chemistry and Physics of Surfaces” (Smith) and “Quantum Computation” (Chamon). In order to accumulate sufficient enrollment, these courses have all succeeded in attracting more students than just those who are being educated for that faculty member’s research group.

In high energy physics for 3-year rotation of advanced courses, there has been faculty interest but no recent opportunity to develop an occasional course on Experimental Issues in High Energy Physics. PY731 General Relativity was last taught in 2009. PY701 Advanced Mathematical Physics was used once for a group of students who wanted to learn differential geometry. With the advent of data collection and analysis at the Large Hadron Collider, we find that 895-898 special topics courses by various High Energy particle physics faculty members are being offered more frequently.

The Physics Department section of the Graduate Bulletin includes a number of courses identified as “Course offered only upon sufficient demand” for which the demand rarely arises. These include PY561, 701, 702, 711, 731, 743, 761, 762, 811, and 842. These can all remain in the approved inventory without appearing in the Bulletin. For the 2012-2013 on-line bulletin, the seldom-taught courses were eliminated. Prof. Smith’s “Physics and Chemistry of Surfaces” has been submitted to CAS NSCC as PY745, for future offerings. Consideration of courses that can be taken by students in the Materials Science and Engineering Program, to be broadened under its new Director, David Bishop, is now on the agenda.
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.
The Physics Department Three-Year Academic Plan has been prepared in the form of an Excel Workbook with worksheets for 1) Course Offerings and 2) Faculty Assignments. Information is given for the current academic year, and the projections are for the requested three years, through Spring 2014.

COURSE PROJECTIONS
The plan incorporates a modest level of course evolution to meet specifically identified needs.

Concerning General Education:

1) Our newest such course, PY103 Cinema Physica, is projected to stabilize at one offering (Spring) per year.

2) Prof. Glashow’s Freshman Seminar on Energy is listed as UHC PY101 in the Spring Terms as of 2011. This course is only available to Honors College students.

Concerning Intro Sequences:

1) The out-of-phase PY106-105 has been successful and is continued.

2) Our Fall Term PY313 Elementary Modern Physics course is continued, perhaps as a placeholder for a rethought offering for engineering students. (or Not?)

3) The Neuroscience Program now requires a year of introductory physics from our existing sequences.

4) PY105-6 has instituted a “studio” section that combines discussion, lab, and just-in time short lectures. It is housed in temporary quarters in PRB 459, and is therefore limited to 36 students. During Summer 2011, a professional architectural study identified space in SCI for constructing a room that can accommodate 81 students, and we have a plan for moving the current labs in that space to other available space. This project is being presented to the University SPACE committee for approval and prioritization. If construction occurs during Summer 2012, the entire PY105-106 course can be converted to this format the following year.

Concerning advanced undergraduate courses:

1) An extension (PY352) of Modern Physics (PY351) for Spring-Term sophomore physicists was approved and implemented beginning in Spring 2010, but thus far we have decided to leave it as an elective course, rather than a requirement.

2) A PY4XX Intro to Optics and Lasers (or perhaps 3XX) is the first of several undergraduate-level “Elementary Intro to” courses that we would like to be able to offer not only to our own students, but also to Chemists, Biologists, and even BME students.

3) With appropriate regularity, the Undergraduate Physics Seminar PY482 was intending to adopt an emphasis that also serves students in the Quantitative Biology program. Now that an annual Quantitative Biology Seminar BI 316 with specific required content has been approved by the Natural Sciences Curriculum Committee, we may encourage interested physics undergraduates to enroll in that course, and encourage interested physics faculty to present appropriate sessions in that course on a voluntary basis.

Concerning master’s level (and advanced undergraduate elective) courses:
1) We have repositioned the introductory content in PY771 Biophysics as PY571 Introduction to Biological Physics, approved last year.

2) We have encouraged Joel Weinstein, our long-term lecturer in PY371/681 Electronics for Scientists, to more clearly separate the introductory/professional needs of undergraduates and graduate students. As the course has evolved, it does not fit graduate students as well. Therefore PY 681 enrollment has decreased.

3) Similarly PY421 has been focused specifically on undergraduates as Introduction to Computational Physics. PY621 is no longer being offered. Professor Rebbi, who teaches PY421, is also discussing with the Biology Department and the Neuroscience Program a change in the topics covered so that the first half of the course can be of value to some of their students as well as ours, and then the two groups would separate for the remainder of the semester. This significant change will have to go through the approval process, once formulated now that he has completed his term as Chair.

Concerning Ph.D.-level courses:

1) The graduate committee has cleared away rarely-offered courses from the online Graduate Bulletin.

2) Now that PY571 has been created as a spring term exploratory elective for the first year grad students and senior undergraduates, an alternate-year PY771 “Systems Biology for Physicists” has been developed, and submitted for approval for offering this Spring

3) PY621, the graduate level version of “Advanced Computing in Physics”, which was offered jointly with PY421, has attracted many graduate students in the past. It should be kept in the inventory until instructors are available to offer it.

FACULTY ASSIGNMENTS
The Deans’ Notes 1-4 reflect our longstanding practice. Perhaps everyone feels that they are exemplary, but we believe that the Physics Department’s history [shown for this entire millennium in the 2009 report] clearly conforms to the noted expectations.

- Our general expectation is that each faculty member will change courses on average every three years. Year One is the challenge of a new assignment; Year Two and Three reflect improvements. Beyond that, the temptation too often is to run on autopilot.

- For the eleven-year period analyzed in our first report, nearly all\(^1\) of our faculty have participated at more than one level, or will do so, reaching different audiences. For this analysis the levels were defined as:

  a) Core Curriculum, Writing Program, Honors Program and UHC,
  b) 1-semester General Education,
  c) 2- or 3-semester undergraduate introductory sequences,
  d) upper-level undergraduate physics courses 355-482,
  e) Masters level and elective undergraduate courses 501-68, and
  f) Ph.D.-level courses 700-898,

\(^1\) The exceptions were Prof. Pan who taught only 2 semesters, Prof. Narain who left just before teaching a graduate course, newly arrived professors, faculty members Whitaker and Ruckenstein with long-term administrative assignments and Prof. Stanley, who leads an internationally-known research group that
supports and mentors 15-25 physics graduate students at any given time. To make this possible Prof. Stanley obtains grant-funded teaching release every semester.

- Over this period, almost all faculty members have had one-third or more of their teaching at the undergraduate level (a-d).²

² The exception is Prof. Castro Neto, who is currently on long-term leave, but is planning to develop an undergraduate/graduate course on the physics of carbon that will emphasize some of the spectacular developments in graphene.

- Enrollment information has not been included. Our matrix is complicated enough.

In general the following sizes pertain to the above levels:

a) ~ 20
b) 15 – 50
c) 25 – 140 per lecture section
d) 20 – 40
e) 15 – 25
f) 5 – 20

- Faculty who regularly take sabbaticals are projected to do so at their first available opportunity.

- Grant-funded teaching release is hardest to predict, except for Prof. Stanley, who has a long record of funding that includes teaching release. More opportunities for faculty members to concentrate on their research with substantial financial return to the College and Department will probably emerge, if the economy and the funding situation of sponsoring government agencies will improve. (someday...?)

- Hiring usually involves at least one semester of Teaching Release for startup purposes, at a time appropriate for each individual.

This plan does not take into account any possible retirements or departures.

An important point to emphasize is that a science department of 39 faculty members translates into coverage of fewer than 30 teaching slots in any given semester. The standard expectation for the sciences is one significant course per research-active faculty member; one out of seven (5) should be on sabbatical; some may be on Grant Funded Teaching Release; some will have reduced teaching because of extensive administrative responsibilities (VP, Chair, Faculty Director); and turnover or expansion will result in a few being on startup teaching release.

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.

As major items of new information this year’s document contains the following:

- The Physics Department and the BU Study Abroad program are continuing an internship program for physics majors at the University of Geneva, and CERN.
- Enrollment in PY211 has increased from 150 in Fall 2010 to 180 in Fall 2011.
• PY105-6 has instituted a “studio” section that combines discussion, lab, and just-in time lecture to provide a more active, hands-on environment for learning. It is housed in temporary quarters in PRB 459, and is therefore limited to 36 students. Over the summer, a professional architectural study identified space in SCI for constructing a room that can accommodate 81 students at nine round tables with three groups of three students each, and we have a plan for moving the current labs in that space to other available space. This project is being presented to the University SPACE Committee for approval and prioritization. If construction occurs during Summer 2012, the entire PY105-106 course can be converted to this format the following year, as was proposed in our successful RULE grant.

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. Accordingly we are currently engaged in a planning process aimed at strengthening and expanding our department’s already vibrant research activity. While this process is perpetual, over the near term we anticipate that it will lead to a plan that envisions a slight reduction of faculty in some areas of research, while emerging areas, such as biological physics, may be strengthened. In particular we will make sure that the Physics Department will play a leading role in university-wide interdisciplinary efforts, such as in material science, where physics necessarily forms a primary ingredient. For the materials science program, we envision that shared courses will be developed, either by suitably modifying existing departmental courses or by developing entirely new courses.

We also hope to make a major inroad in general education by offering a course (or courses) that will help make non-physics students better educated about technological issues upon which our continued privileged lifestyle depends. Examples of such courses are: (i) “Physics for Presidents”, which was developed at UC Berkeley as a one-semester course that covers all the physics that future world leaders need to know; (ii) “The Physics of Everyday Life” that is based on the popular text “How Things Work” by L. Bloomfield; (iii) “Physics of Energy” to educate general-education students about the physical laws and processes that govern the sources of energy, their transmission and storage, and the end usage. For the latter, many such courses are already in existence in the US and we should be able to build on this knowledge base.

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

We recently developed a graduate course in systems biology (PY 771) that we anticipate will also appeal to students in biology and in biomedical engineering. We anticipate that this course will serve as a nucleation point for graduate students with interests in quantitative biology across three departments. Beyond this recent curricular addition, we are not planning to develop new academic programs or make major revisions to existing programs. However we do plan to develop additional courses that will serve the interdisciplinary programs mentioned above. One example would be a one-semester physics course specially tailored for students in the neurosciences.
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.

*Our current offerings are adequate to our undergraduate and graduate programs, but we are trying to increase the number of good quality undergraduate students majoring in physics. We give all our physics majors the opportunity and encourage them to participate in research carried out by our faculty. Given the level of such research, we would be able to accommodate a larger number of majors and we plan to work with the College to increase our enrollment without compromising the quality of the students coming into the major. An important factor in the future growth of the undergraduate physics major is the Geneva study abroad program. A significant fraction of freshman majors were attracted to our program by the Geneva program and the possibility of participating in research at CERN. We are trying to develop a sustainable plan to ensure the viability and excitement of the program over the long term.*

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?

*The courses which we are planning to develop and offer (see “A” above) will be staffed in part by existing faculty, and in part by new faculty whom we hope we will be able to hire in the context of the overall CAS faculty expansion.*

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” these questions are actively considered by our faculty in the context of a medium and long range development plan.*

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.