

Physics Program Review

Faculty of Science

Dean's Summary

Submitted by:

Dr. Greg Schlitt, Dean (Acting) of the Faculty of Science

Accepted by:

Senate in January 2018

Academic Planning and Priorities Committee in November 2017

MEMORANDUM

TO: Dr. Eric Davis, Chair APPC

FROM: Greg Schlitt, Dean of Science (Acting)

DATE: October 23, 2017

RE: **2017 Physics Program Review: Dean's summary and comments**

The department of Physics and its programs underwent review in the 2016-2017 academic year.

The UFV Physics department, a unit of the Faculty of Science, offers the following programs:

- Major degree in Physics
- Minor degree in Physics
- Honours degree in Physics
- Diploma in Engineering Physics (Mechatronics specialty)

The department also provides the first year of an Engineering Transfer Program and several first-year courses which serve other programs in the university.

As an administrative unit it contains seven permanent fulltime faculty members (two of them lab instructors) and frequently employs temporary instructors (as LTAs or sessionals). A departmental assistant (prorated at 40%) assists with administrative duties.

The review took the form of a self-study report written by department members and reviewed by an external team of physicists and engineers. The self-study followed the guidelines for review of programs set by the university.

It was clear to the review committee that the great strength of the department is the dedication and commitment of the faculty to providing an excellent and encouraging learning environment for the students. And indeed that environment has borne fruit: the number of students in the Physics program and number of graduates compares very favourably with institutions much larger, and better-resourced, than UFV.

There are, of course, challenges and room for improvement, as well as opportunity. These were addressed by the external committee in the form of recommendations. In this summary I have listed the recommendations, summarized the department's response, and commented on the recommendation and response, where appropriate.

I have departed from the order in which the recommendations were supplied by the committee in order to group the recommendations in the thematic categories I felt to be pertinent at this stage. The numbering still refers to the numbering supplied by the committee.

Recommendations around departmental policies, activities and directions

Recommendation 1.1 and 1.2 (first point)

The department is encouraged to increase its connection with and involvement in the Canadian Association of Physicists (CAP) by:

- *having one or more members attend its annual national Congress*
- *sending the chair to its annual chairs meeting*
- *inviting students to participate in its Lloyd G. Elliott University Prize Exam, held in February of each year*
- *The department is encouraged to become involved with developments in physics pedagogy by having one or more members attend one of the national meetings of the American Association of Physics Teachers*

Department Response: The department notes that it does in fact have a member who attends the CAP congress yearly.

The department notes that attendance at national meetings and conferences is contingent on funds being available to support the travel and that professional development funds are often already spoken for by other faculty endeavors, but that it may be possible to pool PD funds.

The department will better inform students of the prize exam.

Dean's comments: Funding is indeed available in the form of professional development grants for attendance at national and international meetings pertaining to physics and its pedagogy. If attendance varied among faculty members, there would likely be sufficient funds.

Attendance at an annual chairs meeting is probably not a “professional development” activity and so would need to be funded otherwise. While funds are not unlimited, a request for funding to the dean would be welcomed and it is at least probable that money could be found.

The department might consider weekly “problem sessions” for students interested in writing the Elliot exam, with a faculty mentor(s). Such a session can be more of a joy than an obligation, in that one is working with capable students together on interesting and challenging problems in a subject of mutual interest.

Action: The department to consider the above and advise the dean on outcomes.

Recommendation 1.2 (second and third points)

The department is encouraged to become involved with developments in physics pedagogy by:

- *considering the literature of active learning in physics*
- *making use of the University's Scholarship of Teaching and Learning (SoTL) resources*

Department response: On the first point, see the discussion under the previous recommendation. On the last two points the department responds that although none of the faculty members read the literature on active learning in physics on a regular basis, they can consider increasing that readership. One of the department members makes use of SoTL resources and the department supports other members making use of the same.

Dean's comments: The department places strong emphasis on excellence in teaching: in the words of the review, "The Department of Physics recognizes the utmost importance of undergraduate teaching at UFV. Teaching ability is the foremost criterion governing all departmental sessional, LTA, and permanent faculty hiring decisions. The department places heavy emphasis on student satisfaction as measured by classroom evaluations, and we take great pride in our collective high scores on them." The reviewers concur with this self-assessment, as do I.

However, I would like to see the department move beyond classroom evaluations and their correlates with student satisfaction as the only measure of its pedagogy. The tool is an important one, but has limitations which are well-studied in literature. There is no reason to think Physics is exempt from those limitations. Surely the ultimate goal against which anything should be measured is student learning, and student satisfaction with an instructor is not a measure of that. It may correlate, but that correlation likely hides useful information.

There are scientific, validated tools with which to measure how well course objectives are being met, and the results can be surprising, and here modern tools of (physics) pedagogy may be useful. A famous example is the "Force Concept Inventory" which places students in the position of choosing between "common-sense" notions about motion, force etc. and the facts of Newtonian mechanics. The surprise is how poorly some students who have done well in university physics courses can do on the inventory. The utility is the objective measure one gets of how well a first-year physics course (say) has done in teaching what lies at the very root of the subject, unencumbered by technical proficiency which may substitute for a genuine integrated understanding. Certain teaching methods have been shown to significantly improve scores.

All this is to say that more research and reading in physics pedagogy may serve to improve what the department values most: student learning of physics. And of course there is nothing unique to physics in this regard. Any program could benefit from investigation into the success of its pedagogy.

The UFV Teaching and Learning centre has many resources available that could be of great use to department members as they work towards improving student learning.

Action: As a practical first step towards meeting the external committee's recommendation, I propose an experiment: the department should consider conducting a study, administering the Force Concept Inventory to its students who have completed Physics 111 (Mechanics) and comparing results with those published in the literature, against the stated course outcomes of Physics 111 and against student grades.

Recommendation 1.3

The committee heard suggestions in multiple ways that more cooperation and/or collaboration with the Faculty of Applied and Technical Studies would be beneficial to broader goals of the department and to the student experience. This would be especially so if engineering or applied science initiatives are

contemplated. The committee recommends that a study be conducted that identifies the possibilities for and barriers to expanded collaboration and proposes ways to achieve that end.

Recommendation 1.4

The committee affirms the recommendation of the self-study report that a next step should be to move toward the development of an Engineering Physics degree program. There are many approaches to achieving this aim including partnerships with established programs at other universities. Further, the department is well positioned to lead, along with the Faculty of Science and the Faculty of Applied and Technical Studies, a more broad-based consideration of engineering or applied science programming at UFV. It is apparent that such programming is potentially an important dimension of the University. The University's regional mission and its digital technology ambitions can be significantly strengthened with one or more engineering degrees as part of its profile. The committee suggests this process begin sooner rather than later. Concerns were raised that an Engineering Physics degree or a broader set of engineering degree options could negatively impact (or cannibalize) the Physics degree. The committee agrees this is a real concern and must be actively managed as these ideas move forward.

Department response: The department is strongly supportive of increasing collaboration with the Faculty of Applied and Technical Studies (FATS), and views development of that relationship as integral to the development of an Engineering degree. The department flags the time-resources required on the part of faculty to build a degree proposal, suggesting that course releases be allotted for support.

Dean's comments: UFV is uniquely positioned to take advantage of the hybrid nature of its programming and in-house expertise across its Faculties. An engineering degree, carefully tuned to the resources we have and strategic priorities of the university could be an important and viable addition to our programming, in my view, and in the view of the dean of FATS. I suggest the following steps towards moving the idea forward:

The department and the dean should construct a "business-case" for an Engineering Physics degree, with attention to

- (1) the additional resources required,
- (2) complete utilization of the resources that are in place, including space and equipment available in Chilliwack
- (3) a "marketing" plan, potentially including, in particular
 - i. a plan for a close liaison program with local high school students towards fostering the on-going and on-campus relationships that could feed the program. The department has already taken the initiative in this regard, and may be able to further build on a relationship between the MakerSpace program and its Mechatronics program.
 - ii. some research towards demand for the program, with special attention to a means of getting a realistic assessment of international demand.
- (4) consideration of what other Engineering programs are compatible with Engineering Physics, and take advantage of UFV strengths and leverage facilities like the proposed "Digital Hub."
- (5) an accounting of the estimated impact of an Engineering degree on the Physics degree, and on individual course enrolments within Physics

- (6) collaboration, including the sharing of resources, with the Faculty of Applied and Technical studies
- (7) collaboration with other departments and programs, for example Computer Information Systems/Computer Science

Action: As above, with department and dean responsible, with assistance from the dean of FATS.

Recommendation 1.5

The department is encouraged to develop a science-specific communications course. Such a course will prepare the student for the science and physics discipline-specific tools and standards of communications which currently appear to be learned as by-products of core science courses. There are examples at other institutions of approaches of this kind that have proven to be successful. The committee suggests the department investigate these and consider implementation if deemed feasible and appropriate.

Department response: The department is strongly in favour of such a course, and has the in-house expertise to help in the development of one. Such a course could play a role in a revised BSc.

Dean's comments: I agree that such a science-specific communications course could be very useful to our students, for the reasons stated. It does appear however that there is already something close: Communications 325 "Writing for the Sciences and Technologies." A proposal for a new course would need to clarify why a new course is needed and where the course would be situated.

Action: If the department wishes to proceed, they should begin with a draft outline for the course along with attention to its apparent overlap with CMNS 325.

Recommendation 1.6

The department is encouraged to continue efforts to indigenize the curriculum and teaching methods. While this is relatively uncharted territory for physics programs generally, it presents an important opportunity to address a challenge and improve access and awareness in typically non-traditional disciplines. UFV appears to have very strong resources and—most importantly—the will and ambition across the institution to support such work. From various discussions during the site visit, it was identified that in there were potentially rich ways to indigenize the curriculum that flow from the pedagogy as much or possibly more than the topical content.

Departmental response: Members of the department have been attending sessions organized by the dean (Lucy Lee) on the relationship between science and indigenous ways of learning, and will in the future. "Our primary goal is to teach physics to all who are interested in the subject, and if there are changes we can make that make physics more accessible to a wider audience, we will be happy to make alterations to our curriculum while maintaining its integrity."

Dean's comments: Indigenization is indeed a central concern at UFV, and all departments are tasked with participating in those efforts. In the words of the external committee, opportunities here may lie more in pedagogy than in curriculum. I encourage the department to continue to pay attention to the issue.

Action: Department

Recommendation 2.1

The committee recommends that rank and tenure criteria be completed as a high priority. While there are differences of views with respect to the utility of the criteria, continued delay is a distraction from the excellent work of the department.

Department's response: "At of the time of writing (September 20, 2017), we have not yet received the latest detailed feedback from the Faculty Standards Committee (FSC) on our latest revisions. We are also anxious to have this issue resolved as soon as possible, and are hopeful that it can be completed by the end of this year."

Deans' comments: It is indeed vital that this be resolved as soon as possible, so that the department can move forward. Future hiring, for example, depends on having an approved criteria for rank and tenure in place. The feedback from FSC is now (Oct 23, 2017) available so that the department can revise their standards as necessary.

Action: The department to prepare a revised proposal for its rank and tenure criteria by December 31, 2017, for submission to the FSC in January 2018.

Recommendation 2.3

The committee observed that some teaching members of the department feel excluded from the general business of the department. This does not appear to be deliberate, but rather a by-product of the informal manner of intra-department communication. The department is encouraged to invite all teaching staff to its meetings, so their input can be provided in an official way.

Department response: This is a result of oversight, and the department has already taken measures to be more inclusive of its sessional instructors.

Dean's comments: None

Action: Department

Recommendation 4.2

The Department should seek to increase its research activities by

- 1. holding physics research talks more frequently*
- 2. forming research collaborations within the department and with other institutions*
- 3. including research excellence, especially involving undergraduates, in its hiring, rank, and tenure process*

Department response:

- (1) The Physics Student Association (PSA) is a very active organization, and sponsors a good number of physics and engineering research talks, accessible to students. The department supports them closely, working with them to contact appropriate speakers and facilitate events.
- (2) Two of the current researchers in the department collaborate with other institutions (other universities in one case, and local industry and the BC Cancer agency in the other). The department will work to develop further more connections and collaborations.
- (3) The department values teaching excellence above all in its hiring decisions, and says that the candidate considered best at teaching would always trump another assessed as a lesser teacher

but a better researcher. It points to the success of its students and health of its programs as evidence of the merits of that approach.

Dean's comments:

- (1) The PSA indeed does a lot of great work for their fellow students. In this respect they lead the Faculty of Science. The department works to support them, another example of the close and productive relationship the department has with its students.
- (2) There has been good work done on the part of recent hires on building research connections with local industry and institutions. Connections are in place with local health institutions and local agricultural institutions. This is of tremendous value to UFV and its students.
- (3) That teaching is foremost is not controversial at UFV. Our hiring and system of evaluation, rank and tenure reflect that. Furthermore, our foremost researchers in science are not isolated in labs apart from students, but do tremendous work *with* their students. Teaching and research don't have to be understood as necessarily in tension with each other, especially if the research can involve students. That can be difficult in science, but is by no means impossible, as examples in Physics itself (Derek Harnett and Lin Long) show. The Biology and Chemistry departments have many other examples. This experience is of great value to students, and is an education no less than and often greater than that obtained in a classroom.

A hiring criterion could be, for example, that a candidate present a research program that explicitly has a well-thought-out, feasible and meaningful role for students. That a candidate can do that would speak greatly to their interest in student learning, and ability to support the experiential learning that is a UFV priority.

Action: The department to consider the above, especially in regard to future hiring criteria.

Recommendation 5.4

The committee encourages the department to assemble and maintain an alumni registry. An active and engaged alumni group will support everything from student recruitment to fundraising. They will be the department's best ambassadors. This is an excellent idea, and one we have been contemplating for some time. We do have an informal registry through social media (Facebook), but a more official registry is certainly something we should easily be able to implement going forward.

Departmental response: The department strongly supports the idea and will implement it.

Dean's comments: This is a very good idea and something that could be very useful.

Action: Department

Recommendation around needs and institutional responsibilities

Recommendation 2.2

The department is encouraged to develop a staffing needs plan based on the types of courses needed. While we heard and read suggestions of an engineer and/or an experimental physicist, a needs plan would provide the rationale needed to sell the request to senior leadership.

Departmental response: The department will construct a needs plan, probably to include the hiring of Engineering Physicist.

Dean's comments: I look forward to receiving a needs plan. The plan should be constructed with a conservative assessment of demand for the physics and engineering courses currently in the curriculum.

Recommendation 3.1

Lab space – The committee agrees with self-study and interview commentary, supported by tours of lab facilities, that an additional laboratory is necessary. Specifically, the committee recommends that a dedicated mechatronics laboratory be built roughly collocated to other Physics labs. Such a facility can offer a home for specialized equipment and provide a stable environment for the kinds of experiments and projects typical of mechatronics (a physically large single project spread out over multiple weeks or a full semester, and requiring “afterhours” time).

Departmental response: The Physics department agrees with this assessment, saying they need additional space in order to provide our students with the equipment and resources commensurate with other similar sized institutions.

Dean's comments: The department and its students do need more dedicated space in order to support the sort of long-term experiential learning projects mentioned here. Solutions which would contain the sort of long-term “owned” space mentioned here are not on the medium-term horizon, to my knowledge. As a third priority (behind the Digital Hub and building D and A envelope renewal) there is a proposed expansion to building C which could create, as a result of shifted usage, the sort of space recommended.

However there is another more immediately available solution which also takes advantage of other existing resources, such as equipment: the Chilliwack campus. My conversation with the Dean of FATS (John English) suggest that there is both space and time available there.

The challenges to better utilizing this are

- Transit time needs for students (and instructors) makes scheduling more difficult, essentially ruling out “back-to-back” blocks in physics/engineering and related disciplines like mathematics. I do not think this impossible though, especially as the recommendations pertain to need not necessarily tied to a rigid timetable. On the other hand, a Chilliwack lab would make it difficult for Abbotsford students to “drop-in” and work on their projects as they have time throughout their days, between other courses.
- Transit needs for students: these are greatly alleviated by the shuttle now operating between campuses, which provides 25 minute door-to-door service. While the shuttle is sometimes

overbooked, additional service is being scheduled and the university is cognizant of the value of this service.

- Student willingness to travel: This may be less of a factor than supposed, especially given support for the idea from faculty.

I recommend

- That the department construct a conservative space expansion proposal for the Abbotsford campus addressing the minimal space needs that a Mechatronics laboratory would have. Proposals which reduce existing generally bookable classroom space are not likely to be approved; rather, to increase the field of view for possible space, the proposal should be in terms of square-footage requirements and supporting infrastructure only. There may be creative means by which multiple student projects could share room square footage but be accessed at different times.
- With the medium-term space crisis in Abbotsford in mind that the department construct a hypothetical timetable for the necessary course sections which demonstrates how a Mechatronics student could make use of a dedicated Chilliwack space for a reasonable amount of time per week. The use of “cohort” sections (all Mechatronics students in the same Physics, Math sections) would probably facilitate this. Any drawbacks associated with such a schedule should be listed.

The dean will represent the need for space in his/her role on the Campus Planning Advisory Committee and Deans’ Council, with attention to both better use of multi-campus space and, longer-term possibilities arising from an eventual building C expansion.

Action: Department and Dean

Recommendation 4.1

The University should increase its support for research by:

- *ensuring sufficient research laboratory space is made available*
- *encouraging and supporting faculty research involving undergraduates*

Departmental response: “The department sees no issues with this recommendation, as long as any increase in workload is offset by a decrease elsewhere. We understand and appreciate the importance of undergraduate research opportunities, and would be receptive to any increase in support by the University.”

Dean’s comments: On space see the previous recommendation.

UFV places a high value on research opportunities for undergraduates and the American Physical Society have a number of reports which do the same (reports which also provide some strategies for developing the opportunities.) Financial resources to support this research is limited, but includes

- Funded course releases: research which involves students is one of the prime considerations in the ranking of proposals for these “Research Option” or “Scholarly Activity” grants
- Indirect funding via “Directed Studies” sections (a student’s tuition fees are paid out directly to the faculty member supervising.)

Some science departments, particularly Biology, make extensive use of these to support a good deal of student research. While undergraduate research is more challenging in a mathematical science like Physics however, due to the very vertical nature of the subject, it is not impossible, as the records of physicists Dr. Harnett and Dr. Long show. Hiring with attention to a well-developed program in undergraduate-accessible research will build capacity. As mentioned above, there is literature specifically written for physicists which discusses ways of overcoming the challenges.

Given the value UFV gives to undergraduate research in its self-conception, mission and promotion, I recommend that academic administration allocate more resources to it. Perhaps a separate grant fund could be created (beyond research option and scholarly activity grants) to support research which has a strong student role as a necessary, prominent and well-integrated component. In keeping with UFV's valuing of experiential learning, this could be viewed as a grant in support of student learning as much as of research.

Action: Department, Dean and University.

Recommendation 5.1

Operating budget -- there is a solid perception that the program lacks sufficient annual operating funds. Since the current allocation came into being through an evolutionary means, it is impossible to know definitively if this is the case. Accordingly, the committee suggests two courses of action:

- 1. conduct a zero based (i.e., blank piece of paper) assessment of annual needs. These will include everything from consumables, minor capital items, travel, etc.; and*
- 2. survey other institutions and attempt to draw comparisons based on criteria such as number of students, lab hours, etc. This information will form a rationale for an appropriate request.*

Recommendation 5.2

Capital budget -- the committee recommends a current capital replacement and needs list be prepared and kept updated at all times, as opportunities for funds do arise (although ad hoc) and being prepared to act quickly with clear priorities will maximize the chances of success. While likely an exaggeration, a student comment illustrates the current state of need: we had to fix the equipment in order to do the experiment".

Recommendation 5.3

To more actively address the capital requirements of the department, the committee encourages the department and its institutional partners to collaborate on a long-range capital funding plan. This may require some innovative thinking, but it is apparent that waiting for the traditional capital funding sources to satisfy the long-term capital needs of the department is a disservice to the department and its students. Although the topic was not explicitly dealt with in detail, it is apparent that there are emerging equipment needs coming from new technologies, new methods, and general expectations of students: laser cutting, 3D printing and scanning, small scale CNC fabricating, etc. Such needs should be factored into the capital list. Lagging on these leads to a slow erosion of quality and competitiveness.

Department's response: The department agrees with the analysis of the situation and with the recommendations and will take the suggested courses of action. They comment that there should be more resources allocated within University Advancement to fundraising for minor capital projects such as these.

Dean's comments: At recent budget meetings it has been noted that equipment maintenance and repair needs to be less reactive, and take its place as an ongoing assumption in budget planning. I agree that this is an important principle that needs better attention.

There have recently been considerably more resources allocated to University Advancement to support fundraising initiatives. Once the department has its needs plan in place I can meet with Advancement and the department to discuss how we can move forward on raising funds.

A zero-based assessment of annual ongoing needs will be useful in construction of future budgets.

Action: Department, Dean and University.