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Chair of the Assembly of the Academic Senate
Faculty Representative to the Regents
University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200

April 11, 2018

MICHAEL T. BROWN
PROVOST AND EXECUTIVE VICE PRESIDENT
UNIVERSITY OF CALIFORNIA

Re: Approval of Master of Bioprocess Engineering (MBE) at UC Berkeley

Dear Michael,

In accordance with the *Universitywide Review Processes For Academic Programs, Units, and Research Units* (the "Compendium"), and on the recommendation of CCGA, the Academic Council has approved UC Berkeley's proposal to establish a self-supporting graduate program leading to a Master of Bioprocess Engineering (MBE) degree.

Because this is a new degree title, and the Assembly of the Academic Senate is not meeting within 30 days of CCGA's approval, Council must approve the program per Senate Bylaw 125.B.7.

I am enclosing CCGA's report on its review of the new program, and respectfully request that your office complete the process of obtaining the President's approval.

Please do not hesitate to contact me if you have additional questions.

Sincerely,

A handwritten signature in brown ink that reads "R. C. May".

Robert C. May, Chair
Academic Council

cc: Academic Council
Senate Directors



COORDINATING COMMITTEE ON GRADUATE AFFAIRS (CCGA)

Onyebuchi A. Arah, Chair
arah@ucla.edu

ACADEMIC SENATE

University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200

February 28, 2018

ACADEMIC SENATE CHAIR ROBERT MAY

Dear Robert,

At its February 6 meeting, the Coordinating Committee on Graduate Affairs (CCGA) voted 9-0-0 to approve a new Master of Bioprocess Engineering (MBE) as a self-supporting graduate professional degree program (SSGPDP) on the Berkeley campus.

This nine-month MBE SSGPDP is being proposed by the Department of Chemical and Biomolecular Engineering in the College of Chemistry at Berkeley. It is aimed at recent graduates of Chemical Engineering or related degree programs as well as at early career graduates who wish to specialize and work in the bioprocess engineering industry. The job market for Bioprocess Engineering graduates appears to be healthy, with increasing work opportunities for those whose skills and knowledge can be used to convert chemicals, raw materials, living cells, and microorganisms among others into consumer, environmentally-friendly, or life-saving products.

The program plans to matriculate 30 students in its first year and work towards a steady state of 50 students per year. It will combine requisite courses in biochemical engineering, bioprocess engineering, and biomolecular engineering with possible electives in chemical biology, bioengineering, molecular immunology, protein chemistry, and systems biology. All the students will spend ten half-days during the last semester at the Advanced Biofuels Processing Demonstration Unit of the Lawrence Berkeley National Laboratory that is partly funded by the extramural grants, industry contracts, and the US Department of Energy.

All reviewers lauded the program for its strengths and were favored approving the proposal subject to addressing some concerns. They also made recommendations. In addition, CCGA received a review from the UC Planning and Budget Committee (UCPB) that raised two important concerns that were communicated to the proposers. CCGA felt that both concerns were major and requested the proposers to address them thoroughly.

First, the justification for a five percent annual increase in tuition (which was faster than expected inflation rise) was inadequate to satisfy UCPB's scrutiny. In response, the proposers have agreed to lower the annual increase of tuition to three percent. The second concern of UCPB was that "UCB's plan to mix state-supported and MBE students in classrooms muddies the accounting of costs, as the core of a given course is already covered by the state, and it is unclear that revenue from the program will fully pay for the faculty resources needed to deliver the curriculum to MBE students." Although the proposers' response that this follows standard methodology at Berkeley, it did not fully allay the concerns. However,

relevant policy documents from UCOP and Berkeley provide adequate justifications and safeguards to alleviate the concerns raised by UCPB.

CCGA felt the responses from the proposers were thoughtful and addressed these issues sufficiently. Therefore, CCGA recommends approval of the proposal.

As you know, CCGA's approval is the last stop of the Academic Senate side of the Systemwide review and approval process except when the new degree title must be approved by the President, under delegated authority from The Board of Regents. I submit this for your review and have enclosed the proposer's response. Please do not hesitate to contact me if you have further questions regarding the proposal.

Sincerely,

A handwritten signature in black ink, appearing to read 'Onyebuchi A. Arah', written in a cursive style.

Onyebuchi A. Arah
Chair, Coordinating Committee on Graduate Affairs (CCGA)

cc: Kum-Kum Bhavnani Academic Council Vice Chair
CCGA Members
Hilary Baxter, Academic Senate Executive Director
Jocelyn Banaria, Academic Senate Assistant Director
Chris Procello, Academic Planning and Research Analyst
Fiona M. Doyle, UCB Graduate Dean
Andrea Greenrush, UCB Senate Executive Director
Sumei Quiggle, UCB Senate Associate Director
Sumali Tuchrello, UCB Senate Analyst

Enclosures (1)

Final Report on CCGA Review of MASTER OF BIOPROCESS ENGINEERING: A Self-supporting Graduate Professional Degree Program at Berkeley

By: Teamrat A. Ghezzehei, Merced representative to CCGA (2017/18)

January 28, 2019

Synopsis

The Department of Chemical and Biomolecular Engineering in the College of Chemistry at Berkeley proposed a 9-month self-supporting graduate professional degree program in Master of Bioprocess Engineering, which is intended for recent graduates with degrees in Chemical Engineering or other related disciplines or those who are relatively junior in their careers who wish to specialize in the bioprocess engineering industry. The program expects to matriculate 30 students in the first year, increasing steadily each subsequent year to attain a steady state of 50 students per year. It combines requisite courses in biochemical engineering, bioprocess engineering, and biomolecular engineering and electives. Every student is expected to spend ten half-days during the last semester at the Advanced Biofuels Processing Demonstration Unit (Lawrence Berkeley National Laboratory) that is funded in part by the US Department of Energy, extramural grants, and industry contracts. The proposers addressed the comments thoroughly and adequately (see attachments). A brief summary of the main points follows:

Reviews

Request to review the proposal was sent to 11 qualified individuals (six internal from within the UC system and five external). Three external reviewers agreed to review the proposal, but only two returned their reviews. One internal reviewer agreed and returned reviews on time. Both external reviewers—Dr. Jonathan S. Dordick (Rensselaer Polytechnic Institute) and Dr. Mike King (University of Virginia)—chose to disclose their names to the reviewers but the internal reviewer to remain anonymous. All reviewers lauded the program for its strengths and were in favor of approving the proposal subject to specific questions or made recommendations the provided.

1. Dr. Dordick raised concern about lack of clarity regarding the contents of the project and export-control issues given that 50% of the students are likely to be international. He also had question about lack of diversity plan in the proposal. The reviewers provided additional clarifications and details on their plans for student projects and indicated that they plan to implement non-disclosure agreement. They suggested that the future director is expected to draft full plan of recruitment that includes strategy to reach URM students. They provided some potential directions that they plan to follow in this direction as well.
2. Dr. King indicated that he teaches a course in Bioproduct and Bioprocess Engineering at UVA. Previously, he had a 32-year career at Merck and Co., Inc. ending as Senior Vice President of Science and Technology. He also indicated to have a “good grasp of the challenges in bioprocess

engineering for successful commercialization of biologics from both an industrial and academic”. He made two recommendations to improve the proposal: (a) specific topics that should be included in the 295 series courses and (b) need for industrial advisory board. The proposers agreed with both recommendations and indicated how the plan to implement them. He also had two questions regarding (a) how bioanalytical technologies in are going to be incorporated in the core course curriculum and (b) whether sufficient funds have been allocated for technician support for the the hands-on training. The proposers shared their specific plans that address both questions adequately.

3. The UC Internal reviewer asked for clarifications regarding the funding scheme of students projects and the specifics tools that they will be trained on to conduct techno-economic modeling of bio-processes. The proposers indicated their plan to use both company-sponsored and federal research grants for student projects.

In addition, CCGA received a review from UC Planning and Budget Committee (UCPB) that raised two important concerns that were communicated to the proposers. CCGA felt that both concerns were major and requested the proposers to address them thoroughly.

First, the justification for 5% of annual increase in tuition (faster than inflation) was an adequate to satisfy UCPB’s scrutiny. In response, the proposers have agreed to lower the annual increase of tuition to 3%.

The second concern of UCPB was with “UCB’s plan to mix state-supported and MBE students in classrooms muddies the accounting of costs, as the core of a given course is already covered by the state, and it is unclear that revenue from the program will fully pay for the faculty resources needed to deliver the curriculum to MBE students.”. Although the proposers response that this follows standard methodology at Berkeley did not fully address the concerns adequately, relevant policy documents of UCOP and Berkeley provide adequate justifications and safeguards to alleviate the concerns raised by UCPB. These existing policy and procedural safeguards are:

1. Section III-P (Page 8) of the UCOP-SSGPDP Policy (2016) (attached) allows concurrent enrollment of self-supported and state-supported students, provided that separate accounts are maintained for each program. It also allows the campus to levy appropriate ‘charges’ as long as the tuition, fees and charges are not blended (these terms are defined in Section II E and F).
2. UCB-SSGPDP Policy (2018) is consistent with the UCOP policy and provides specific guideline for concurrent instruction that I believe adequately protects the interests of the state-supported students (see sections that I highlighted, especially Section III-D and IV-D).
3. There is a template MOU in the Berkeley policy that dictates the terms between the state-supported program offering courses and SSGPDP (attachment D to policy).
4. The fee level of USD 750 is derived from what UCB Extension charges for concurrent enrollment of extension students in state-supported courses. It is safe to assume that these fee structures have been scrutinized before as they have been in place for much longer time. <https://extension.berkeley.edu/static/studentservices/concurrent>
5. Some of these ideas appear to have originated from a joint Admin-Faculty task group. In their report issued in 2011, they recommended using the established extension program mechanisms for administering for concurrent enrollment of SSGPDP students in state-supported program as part

of their answer to: “How can the campus avoid waste and duplication in self-supported programs by leveraging extant courses without crowding out state-supported program students?”. They also recommended the use of individualized MOU for record keeping. (https://grad.berkeley.edu/wp-content/uploads/tfssdp_report.pdf). Senate deliberations regarding the UCB policy are password protected (perhaps the Berkeley rep can check if needed), but it appears that Berkeley DivCo has weighed in on this report. (<https://evcp.berkeley.edu/initiatives>).

In summary, the proposal along with the responses to the concerns to questions that were raised during the CCGA review processes adequately meet scrutiny of CCGA. Therefore, I recommend approval of the proposed program.

TO: Professor Teamrat A. Ghezzehei Chair,
Senate Graduate Council
RE: External Review of Prf. Michael King

Thursday, July 19, 2018

On behalf of CBE, I am pleased that Professor King of the University of Virginia strongly supports our proposal for a Masters of Bioprocess Engineering, and we are glad to respond (below) to his very constructive comments.

1. The need to include bioanalytical technologies in the core course curriculum. How will the Program Director, who should be a PhD with a strong background and record of achievement in industrial bioprocess engineering incorporate this into the 295 series?

Our internal committee that prepared this proposal has indeed identified bioanalytical technologies as a critical area. This is also affirmed by colleagues in chemical biology and bioengineering. Towards that end the degree program, if approved, will recruit a director that has a PhD and extensive knowledge and experience working in the industrial bioprocess engineering field, including analytical methods. The director is expected to include in the lecture portion of CHM ENG 295C (Bioprocess Engineering) a review of the bioanalytic techniques, which may include hyphenated techniques, chromatographic methods, electrophoresis, ligand binding, mass spectrometry, and/or NMR. The practical application of these procedures will be used during the CHM ENG 295E (Bioprocess Engineering Laboratory) course depending on the type of sample(s) that is analyzed at the ABPDU and during the capstone projects. In addition, bioanalytical technologies predominately comprise the CHM ENG 170L course, which is a pre-requisite or required course for all of the program's students to successfully fulfill to complete the program.

2. 295 series should also include topics such as process equipment selection (SS or single use equipment), GMP (Good Manufacturing Practices) regulations, Quality by Design (QbD) methodology, both product and process economic analysis, risk and risk mitigation strategies, and how to integrate bioprocess engineering in the overall product development plan while minimizing the critical path timeframe.

We agree, and these topics are already specifically listed as part of the curriculum for the CHM ENG 295D (Advanced Bioprocess Engineering) course. The course description for this also includes industrial speakers as an integral part of the instruction.

3. Institute an Industrial Advisory Board who can consult on which emerging topics to include in the curriculum and engage industrial experts to teach some of the courses.

The College's Advisory Board is well-represented by experts from premier industrial companies in biotechnology, pharmaceuticals, and the chemical sciences. The Advisory Board has been following the progression of the proposal of this degree from the beginning and is very supportive of its potential launch. It is a wise and feasible suggestion to establish an Industrial Advisory Board for this degree, which could be a subset of the College Advisory Board.

- 4. Significant preparation work in advance of the ABPDU lab should be provided so that the students can focus on the hands-on training with the equipment. It was not clear whether such technician support is included in the APBDU budget line item.**

The budget includes the equivalent of two 0.75FTE ABPDU personnel for the full year, which can certainly accommodate time and effort to prepare the students in advance of their 10 half days during their second semester.

I hope these comments address Professor King's thoughtful review.

Respectfully,

A handwritten signature in blue ink, appearing to read "Jay De" followed by a long horizontal flourish.

Responses to MBE External, Internal and UCPB Reviews

Professor Jonathan Dordick, Rensselaer Polytechnic Institute

- 1. One concern is that the actual capstone course activities are not clearly evident in the proposal. It would have been useful to have an example of a project and how it can be broken down into components within the 10-session timeframe. Furthermore, it would have been useful to know what will be the expectations of the students in this capstone and how will student achievement be assessed.**

Finally, has U.C. Berkeley addressed potential export control issues related to industry-based confidential projects? While it is an educational program, with 50% of the students expected to be international, this issue may become a concern.

During the first half of the time at the ABPDU, the MBE students would work under the supervision of ABPDU Research Scientists to undergo training and perform process execution at the bench and pilot scale for a subset of the ABPDU's raw upstream material handling (media and reactor prep, biomass extraction, etc.), fermentation, and downstream processing (centrifugation, filtration, chromatography, evaporation, etc.), unit operations. Following this initial training and verification of proper hands-on equipment operation, the MBE students will work as a team with their ABPDU supervisors and interact with one of the ABPDU's industry partners at the time of the capstone. This would entail initial meetings and discussion with the partner, followed by hands-on participation in the sponsored research project, and the preparation of a written report detailing the process challenges, issues and opportunities for the specific industry partner.

Every student will be required to sign a non-disclosure statement (NDS) to participate in any industry-based projects at the ABPDU and/or industry partner. Since completing a project is required to fulfill the requirements of the degree, any student who declines to sign an NDS will be assigned to complete a project based upon published literature and business case studies or a federally funded project. This may limit the breadth of the student's experience but would be a result of their personal decision to not sign an NDS. In addition, the ABPDU is not currently performing work with any export-controlled information or materials. The ABPDU has an agreed process in place, with the LBNL Director, to manage the potential time spent by students or postdocs on such projects and does not anticipate MBE students having access to this information or materials.

- 2. The strategy to target URM students, however, was not discussed explicitly in the proposal.**

It is true that the proposal does not include a specific plan for outreaching to underrepresented minority (URM) students since the Program Director, once hired, will be responsible for designing and executing a full implementation plan to recruit and

outreach to URM students. At a minimum, the plan will include targeted outreach to our own undergraduates at UC Berkeley and in our College, at other UC campuses, at historically Black colleges in the US, and with our institutional partners across the country. Participation in career fairs at select locations will supplement our efforts. However, we will not be limited to these strategies alone to ensure we cast a wider net for qualified students.

Internal UC Reviewer

- 1. It was a bit unclear about whether the projects the students are working on at ABPDU are part of a funded contract with industry or a separate unfunded collaborative project between the MBE program and the company that utilizes the ABPDU facilities. The only other concern I have is that cost-effective manufacturing is mentioned throughout the introduction but I had a difficult time figuring out where the techno-economic modeling of bioprocesses is taught, what computer aided tools (Aspen, SuperPro Designer, Biosolve) will be utilized, where they will learn how to use those software tools, and how much time the students will spend on the techno-economic modeling project.**

The industry projects the students would work on and be exposed to would be sponsored either by the companies themselves or Federal agencies under competitive award or directed funding. The MBE students would work under the supervision of ABPDU Scientists and Engineers, in a similar manner to how we include undergraduate interns in such activities, but of course at a more advanced and deeper level given the higher degree of training and experience the MBE students will have gained. The ABPDU also routinely uses SuperPro to perform techno-economic analysis, and we would envision the MBE students being introduced to this tool and some standard models the ABPDU has already developed for different bioprocesses and related upstream and downstream unit operations.

UC Planning and Budget Committee

- 1. The rate of tuition increase at an annual rate of 5% is faster rate than inflation. It does not appear that adequate justification was provided that satisfied UCPB's scrutiny. The proposal provides two budget workshops. In the first, the program will start generating surplus from year one at 164k/year (45k per student) and this will rise to total of 1.25 million/year (25k per student). The fee on year 5 is 65k (or 37% of the fee will be surplus). A revised budget template provided in response to internal comments shows a deficit of 26k in the first year, but surplus from second year at 147k, 347k, 750k, 960k. In year five the surplus is 30% of the program fee.**

The campus-approved financials for the program escalated each year by 5% since that is the Campus guidance for new initiatives at UC Berkeley. When we revise the annual escalation for tuition and expenses to 3% after the first year, the ending balances each

year become \$110K, \$258K, \$594K, and \$722K. These surpluses will allow the program to design new courses that students may choose as their electives, to increase the number of graduate student instructors for each class, to decrease the student to faculty ratio by hiring additional instructors and increasing the number of sections provided, and identify and renovate additional space for the program. These improvements would benefit our State-funded students since any new and existing MBE courses would also be available to them.

- 2. In a section titled "Impact on State-Supported Programs" your proposal states: "the courses required for the MBE program are courses that are already being taught and can accommodate additional students", and that the state-supported faculty member teaching the course, or their department, will be compensated at \$750/unit per student. UCPB commented that "UCB's plan to mix state-supported and MBE students in classrooms muddies the accounting of costs, as the core of a given course is already covered by the state, and it is unclear that revenue from the program will fully pay for the faculty resources needed to deliver the curriculum to MBE students." Can this under-compensation of costs carried by the state-supported program explain the rapid accumulation of surplus?**

The compensation model of \$750/unit/student is the standard methodology for all concurrently enrolled students at UC Berkeley. Every concurrently enrolled student at UC Berkeley pays this tuition rate. We propose to pass the entirety of this rate to the faculty teaching the courses attended by MBE students. The question of whether this rate fully pays for faculty resources needed to deliver the curriculum is a relevant one that applies not only to this program but to other campus instructional programs and campuses as well. Some sister campuses charge far less than UC Berkeley's concurrent enrollment tuition rate of \$750/unit/student (e.g., \$402/unit, \$466, and \$295). The question seems to be a larger issue than what can be addressed by one degree program.

A perceived rapid accumulate of surplus may be a result of the projected increase of enrolled students. Certainly, the projected surpluses would not materialize if the actual enrollment is static or decreases. We do expect that with an increase in enrollment, more services and infrastructure will be augmented through the surplus balance. Specifics have not been budgeted to allow the Program Director to dictate how such investments should be made for the program based upon the demographics and needs of the students and curricula.