Review on Graduate Program of Chemical Engineering, Texas Tech University

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Program Overview and Vision

The department’s mission is to develop chemical engineering knowledge through research and disseminate knowledge through quality education for graduate and undergraduate students. The department strives to be the undergraduate chemical engineering department of choice in Texas and a top research department for graduate students in the nation. These goals are consistent with the missions and visions of many top chemical engineering departments in this country.

The department currently has 12 faculty, with 36 Ph.D. and 9 M.S. students, and an annual research expenditure of $2.3M. The current faculty size is below the national average for the top 50 chemical engineering departments. However, student number and annual research expenditure per faculty for the department are comparable to the top 40-50 chemical engineering departments in the country. The department is currently recruiting more faculty; In addition, the department plans to increase graduate (primarily Ph.D. student) enrollment to 60, improve the quality of graduate students, and build research strength in selected areas. The department is moving in the right direction.

The department is led by Department Chair Dr. Karim, who was also in charge of the graduate program until recently. Dr. McKenna was recently appointed director in charge of graduate affairs. This new appointment was a timely and positive move much needed to build a stronger graduate program in the department.

The overall rating for the program is “excellent”.

Faculty Productivity

The faculty in the department includes 6 professors and 6 associate professors. A new assistant professor will join the department in 2009. The department is currently recruiting more faculty and it is suggested that the emphasis be given on recruiting junior faculty in order to have a faculty with a balanced distribution of three different ranks.

The department has a strong faculty. All the faculty members have excellent education background. Four faculty members are NSF Career award recipients, and several faculty members (e.g. McKenna) are well recognized in the chemical engineering community. Within the past few years, the faculty has published about 50 journal papers and graduated 4 Ph.D. students each year. On average each faculty member publishes about 4 journal papers per year and supervises about 4 graduate students with annual research expenditure of about $200K. As with most chemical engineering departments, there is
some disparity in faculty productivity in this department. However, the majority of the faculty is active in research and graduate education.

The current research expenditure is consistent with the graduate enrollment in the department (about $40-50K research expenditure per student). These productivities are comparable favorably to the top 40-50 chemical engineering departments in the country. If the department wants to increase graduate enrollment to 60, the research funding will need to increase by about 50%. Increased funding can be achieved through increasing faculty size or further improving the research productivity of the current faculty.

Many faculty members publish papers in top journals in their fields. SCI citation data shows that the papers published by the faculty in the department were cited about 600 times in 2007. This seems to be a good citation number for chemical engineering papers. The citation number can be substantially increased if the department hires one or two well recognized faculty members working in hot research areas.

Many faculty members are active or play a leadership role in their professional societies. Several faculty members are editors or on editorial boards of professional journals, and three faculty members are fellows of six professional societies. Also, many faculty members organized or chaired symposia or sessions for professional meetings.

The faculty appears to have adequate teaching load. In general, a ChE department with 12 faculty should be able to cover all the required undergraduate and graduate courses with an average teaching load (3 courses per year) unless the courses are offered in double-sessions. More faculty members are needed if the department wants to offer more dual-level or graduate elective courses, which is important for a department with a large graduate enrollment. The total work load and faculty service are comparable to other chemical engineering departments in the major research universities in this country.

The overall rating for the faculty productivity is “good”.

Quality and Quantity of Graduate Students and Graduates

On average the department received about 65 applications for graduate study each year, and made about 20 offers (30% acceptance rate). About 90% applicants are international students. The quality of the applicants seems good from the GPA (averaged about 3.5) and GRE scores (averaged 780 for quantitative). The domestic applicant pool is small and most of them are graduates from TTU chemical engineering department. This reviewer however is unable to assess the quality of the small pool of domestic students. It should be noticed that it is difficult for engineering departments to attract domestic students in part because of the high entry level salary enjoyed by the engineering college graduates. The department strength and ranking, financial package of the offers, and location of the university are important factors determining the number of domestic applicants for a department.
The department graduates about 3-4 Ph.D. students and 4 M.S. students each year (with fluctuation in Ph.D. degree awards each year during the past 6 years). The average time to degree is about 4.5 and 2 years respectively for Ph.D. and M.S. This is consistent with most research active chemical engineering departments in the country. The department started to emphasize referred journal publication of graduate students, as indicated by the steady increase in the number of the referred journal papers from dissertations from 1 in 2001 to 15 in 2006. Compared to about 50 journal papers published by the faculty in 2006, less than 30% papers were on the work conducted by graduate students. These data indicate that the faculty published papers primarily on work either conducted by the faculty itself or in collaboration with post-doctors and colleagues outside the department. There is room to improve graduate students’ publications on their dissertation or thesis work.

All the graduates from the department were employed by industry or found post-doctoral research positions in well-known universities. Many students also received various awards for their excellent performance and papers presented in professional meetings. However, from 2001-2007 no graduate from the department has been placed as faculty in academia. Placing graduates in academia should be a goal for the department in order to improve its ranking.

The department provides a stipend of $1,650/month ($19,800/year) for Ph.D. students. This is close to the national average ($21,612/year in 2006) for the stipend for incoming chemical engineering graduate students. However, each student needs to pay $3,500 for fees and health insurance cost. Subtracting this from the amount of the stipend mentioned above, each graduate student in the department in fact receives only about $16,000/year stipend, far below the national average. This financial deficiency is a major hurdle in attracting good quality students. Since the grant size is usually fixed, increasing the stipend offered to graduate student to offset the fees and insurance cost is unrealistic and can put a huge burden on the faculty. Furthermore, there are very limited fellowships for the graduate students. The department will need to work with the university to come up with the resources and mechanisms to increase the actual stipends received by the students.

The rating for the quantity and quality of the graduate students is between “good” and “satisfactory”.

**Curriculum and Programs of Study**

Ph.D. students require a minimum of 60 credit hours of course work, including research, and 12 credit hours dissertation. M.S. students require a minimum of 30 credit hours including 6 credit hours of thesis. All graduate students are required to take the following 5 required courses: two mathematical related courses: (1) Advanced Chemical Engineering Techniques (5310) and (2) Digital Computation for Chemical Engineers (5323), and (3) Fluid Transport Principles and Analysis (5312), (4) Advanced Chemical Engineering (5321) and (5) Reaction Kinetics (5343).
The program does not make specific requirements for elective courses for M.S. and Ph.D. students. Graduate students take elective courses related to their research upon recommendation by their advisors. The focus research areas for the department are (1) Polymer and Materials Science, (2) Process Control and Optimization, (3) Computation Methods in Chemical Engineering, and (4) Bioengineering and Biotechnology. Faculty in the department offer more than 20 graduate level elective courses in these areas. Therefore, there are sufficient elective chemical engineering courses for graduate students.

All graduate students are required to attend weekly graduate seminars delivered mainly by outside speakers. In the past few years the department has put together excellent seminar programs with many renowned speakers in chemical engineering and chemistry communities. The seminar programs improve the visibility and reputation of the department and the students are satisfied with the seminars. However, students express a desire to have more interaction with the outside speakers visiting the department for seminars. One suggestion is to arrange half an hour “meet the seminar speakers” for graduate students so they can interact with the seminar speakers.

The Ph.D. qualifying examination includes both written and oral portions. The oral portion of the qualifying examination is preparation and defense of a research proposal. The topic of the proposal should not be of the student Ph.D. dissertation research. Since the department does not have its own graduate student handbook, this reviewer is unable to learn other details on the graduate program, including format of written examination and residence requirements.

In summary, the graduate program and curriculum in the department are similar to the graduate programs in chemical engineering programs in other research intensive universities in this country. There appears to be a tendency to simplifying qualifying examinations in other chemical engineering departments so the students can focus on their dissertation research early on in their study in the program. It is also suggested that the department makes it a top-priority to develop its own graduate student handbook giving details of their M.S. and Ph.D. programs.

The overall rating for the curriculum and program of study is “good”

Facilities and Resources

The individual faculty members appear to have well equipped labs and research facilities for graduate students to conduct dissertation or thesis research. The department currently has a total lab space of about 10,000 sq ft. The lab space will increase to about 12,000 sq ft at the end of 2008 when an expansion project is completed, giving each faculty member an average of 1000 sq. ft of lab space. The lab space appears inadequate for the chemical engineering faculty of present size and research productivity. The availability of adequate lab space will be key to the growth of the faculty and research productivity for the department.
The university has adequate library resources and information technology to support the graduate program in the department. It is not clear to this reviewer the availability and accessibility of centralized facilities such as expensive material characterization equipment. Such centralized facilities are important to research conducted by several chemical engineering faculty.

The Department appears to have 3 staff members (total faculty and staff of 15 for 05/06) to support the teaching and research. This is low compared to other research active chemical engineering department of similar size. However, despite the low number of staff, it appears that the department has been able to provide adequate support to faculty and graduate students in contracted research. It is certain that an increase in the staff support will further improve faculty’s productivity on teaching and research.

The rating for facilities and resources is “satisfactory”

Summary

The department has a clear vision to become a top graduate program in the nation. The faculty’s productivity and the strength of graduate program have substantially been improved in the past 5-6 years. The graduate curriculum is comparable to other research intensive chemical engineering departments in the nation. The quantity and quality of graduate students are good. Overall, the department is in good trajectory to become a top 50 graduate program in the nation.

To improve the quality of international graduate students, and quality and quantity of domestic graduate students, the department needs to work with the University to increase the actual stipend received by the students. Increased efforts in development may bring in resources that could partially address this issue and provide fellowships to attract high quality students. The department needs to increase the lab space and improve staff support commensurate with the growth of the faculty size and research productivity.