Sloan Career Cornerstone Center

Profiles of Chemical Engineers

John Tharakan

Associate Professor
Howard University
Washington, DC

Education:
B.S. - Chemical Engineering, India Institute of Technology, Madras
M.S. - Chemical Engineering, University of California, San Diego
Ph.D. - Biochemical Engineering, University of California, San Diego

Job Description:
Associate Professor of Chemical Engineering

Advice to Students:
"I think that's very important is to be aware of the different social, political, and economic issues that are current. They have a big impact on what types of technologies get pursued, on what types of research gets done, funded, and supported."

Video Transcript 1:
"The primary responsibility in teaching is to get information across, and to get information across to your students in a manner in which they are able to understand it. The bulk of my time is spent on preparing for class. So for each hour I might be in class lecturing, I would probably spend about two to three hours preparing for that lecture. Now of course, you've delivered the material, you have to be able to assess that the students have, in fact, understood what you've taught, and so the second part of teaching is evaluation. In a department that offers a master's degree, probably the breakdown is around 40% of your time is spent on research, 40% is on teaching. In a research focused university where the department offers Ph.D. degrees, usually the time split is more like 60% for research and 20% for teaching. The other 20%, is service. This sort of time is time that might be spent on committee work. It might be spent on administrative matters, dealing with students from an advising perspective and from a counseling perspective."

Video Transcript 2:
"Well, I think first and foremost, they do need to have a solid grasp of chemical engineering fundamentals. This of course, includes an understanding of kinetics and reactor design, of various transport phenomenon, such as fluid mechanics, mass transfer and heat transfer, material in the energy balances, and all of these are basically the core courses."

Video Transcript 3:

"The most important thing for them to do is to keep abreast of issues because technology is changing very, very rapidly. The second thing I think that's very important for a student to do is to be aware of the different issues that are current at the time because I think the social, political, and economic environment have a big impact on what types of technologies get pursued."

Interview:

Tharakan: My name is John Tharakan. I'm an associate professor of chemical engineering here at Howard University, which basically means I do research and teach, with more emphasis on the teaching.

Q: How did you become interested in teaching?

Tharakan: My first experience with teaching was as a teaching assistant in graduate school. After I finished my Ph.D., I went to work for industry for about four years. I decided that the amount of interaction I had with people in industry was quite little, and I was limited in the type of research that I could do, because the research was always focused on what the industry or the corporation was interested in. So I applied for academic jobs because I decided that only in academia would I have the freedom to-or at least a larger measure of freedom to-do research that I was interested in and to teach the kind of courses that I wanted to teach.

Q: What are the responsibilities of a university professor?

Tharakan: The primary responsibility in teaching is to get information across to your students in a manner in which they are able to understand it. The bulk of my time is spent preparing for class. For each hour I might be in class lecturing, I probably spend about two to three hours preparing. Once you've delivered the material, you have to be able to assess that the students have, in fact, understood what you've taught, so the second part is evaluation. This includes assigning homework and problem sets, making up exams and quizzes, and designing projects that the students can get involved in. All these quizzes, assignments, tests, and projects need to be graded. So, on top of the preparation and the teaching, you have to devote time to evaluation-grading and basically evaluating student performance. So if I were to break it down, I'd say probably about 30% of your time is spent teaching, 40% is spent preparing to teach, and the other 30% is spent on grading and evaluation.

Q: Tell us about your responsibilities as they pertain to the research aspect of your job?

Tharakan: A faculty member has the responsibilities for teaching and research. Depending on the type of university and the level of dedication to research, the weight given to both those areas differs. At Howard, we have a graduate program, but it's a graduate program that only offers a master's in chemical engineering, as opposed to both a master's and a doctorate. Therefore, we have a lower population of graduate students than you might see in a large department that also offers Ph.D.s. As far as research is concerned, the effort that's involved is broken up into a number of different areas. First, you need to be able to conceptualize research problems that have to be relevant to the current state-of-the-art in any particular field. It involves quite a bit of research-finding out what other people have done, reading papers,

evaluating and reading proposals that others might have written to see where the state-of-the-art is. Once you've done that, then you have to develop a proposal, which will basically be sent out to a foundation or a granting agency. They will then evaluate the proposal, and if they decide that it's worth funding, they will give you a grant. Now the ball is back in your court. You have the grant, which is used to do a number of things. The primary thing it's used to do is support graduate students, because graduate students are the ones who do most of the laboratory work as far as the research project is concerned. The second part of the funding has to do with supporting the research from an equipment perspective. An experiment needs certain amounts of equipment or specific supplies and some of the funds have to be utilized for that. Once the research has been done and you've gotten some results, you need to evaluate those results and write a report to the granting agency indicating how you spent the funds, what sort of results were obtained, and where these results will lead to, from a scientific and an engineering perspective. You also need to get that information out to your peers. Once you've generated a report, you will use the data and your interpretation of the data to write a publishable paper, which you will then send off to a journal. The journal will then review it, and if it decides that it's acceptable, will publish it. Research doesn't always follow that smooth progression. Very often, faculty are involved in a number of different projects at the same time. Funding is not as abundant as it was 10 or 15 years ago. The amount of time that is actually spent conducting research at the laboratory bench is much less than the amount of time that is spent generating proposals to obtain funding to keep your research program going.

Q: How does your time break down between teaching and research?

Tharakan: There are some departments that do not have a graduate program at all. All they do is offer an undergraduate degree. In those departments, there's usually very little emphasis on research. The bulk of your time is spent teaching. In a department that offers a master's degree, probably the breakdown is around 40% of your time is spent on research, 40% is on teaching. In a research-focused university where the department offers Ph.D. degrees, the time split is more like 60% for research and 20% for teaching. The number of courses that you're required to teach every semester or every quarter is much less. In both cases, the other 20% is service-time spent on service to the department and to the university. It might be spent on committee work, administrative matters, advising or counseling students, or other bureaucratic matters.

Q: What do chemical engineering students need at the undergraduate level to be successful in today's market?

Tharakan: First and foremost, they need to have a solid grasp of chemical engineering fundamentals. This includes an understanding of kinetics and reactor design, of various transport phenomenon-such as fluid mechanics, mass transfer and heat transfer, and material in the energy balances. All of these are the core courses within any good chemical engineering program. So you do need to have a good foundation in the basics of the field. In today's industrial and political and social environment, I think it's essential that students also have a good understanding and grasp of matters that don't directly concern chemical engineering, like policy issues or the state-of-the-art in the different areas of research, different technologies. It's important to have a fairly broad perspective on your education. It's not enough to know the fundamentals of chemical engineering. It's also important to know how to communicate them.

To see how chemical engineering relates to the world, how it relates to problems that the world is facing right now. These problems might include environmental or energy-related problems.

Q: Why is it not enough just to have the technical skills that a chemical engineering curriculum offers?

Tharakan: One of the main things that you do in industry is communicate. You have ideas, and you work on certain ideas and projects-maybe by yourself, but increasingly it's not. It's as a team. The cooperation within the team has to be very good for the projects that you work on to be successful and that requires effective communication. Team members have to be aware of how their project fits into the overall policy goals of the industry or the corporation, in particular, and also how it impacts society in general. The industry is not just involved in creating products that it sells. It sells them to specific individuals, and they sell them within a certain market. That market, and those individuals, are informed by government policy and current tastes. All those things have a bearing on how a project gets worked out, and how it develops to its end result. Those are some ways that these other considerations, aside from just the fundamentals of engineering and chemical engineering, have an impact on your performance in industry.

Q: If you're interested in becoming a professor, what should you focus on at the undergraduate level?

Tharakan: To get into chemical engineering education as a profession is a fairly long and arduous task. In order to teach in a university, you need to have a doctorate in chemical engineering. Usually, this means another four to six years of schooling after you've gotten a bachelor's in chemical engineering. The other thing that you need to keep in mind is that a lot of your time is going to be spent interacting with students. Interacting with people has to be something that gives you pleasure, because if you find that it doesn't, then education is going to become a burden as a career. So, in addition to the academic work that's required to get your doctorate, you also need focus on people issues-how well you interact with people. Do you find it rewarding to talk to fellow students and try to educate them about some issue, or explain a particular topic in a given subject? Can you communicate your ideas effectively? Communication is a skill that certainly needs to be developed if you want to be a good educator. You also need to be very sensitive to different types of people. As you teach your classes, you'll get students who will be from a wide cross-section of backgrounds. You can have students from different cultures. You can have students from different social and economic backgrounds. Students might have gone to a very good high school or one that didn't train them as well. You have to be able to interact with these different kinds of people in a positive way, because your main job is to educate in a way that is empowering to the student. If a student has particular weaknesses, you have to be able to work with those weaknesses and help the student improve. There really is a lot of responsibility on you as an educator. Sometimes it's a frustrating job, but usually it's very rewarding to see the people whom you have taught get out into the `real world' and make successes of themselves.

Q: Is it important to have experience in industry if you want to become an educator?

Tharakan: Experience in industry is valuable. It's not considered absolutely necessary. Now I'm seeing selection committees and hiring committees that are looking at individuals who are not the `straight-through' type. They haven't done their bachelor's, their Ph.D., and take a job

as an educator or a professor in the university. Instead, they're trying to look for people who have done their Ph.D.s, but have also gone out into the real world and have at least some experience with industry. On the whole, experience in industry is a definite advantage if you're considering a career in education.

Q: What behind-the-scenes things do you have to do, that students may not be aware of?

Tharakan: A large amount of my time is spent in preparation for class. That involves consulting different books, looking at the textbook that has been prescribed for the course, and talking to different educators who've already taught the course to see what ideas they've had. There's a lot of time involved in preparing the course and material and making it accessible to students.

Q: What advice would you offer someone interested in becoming a chemical engineer?

Tharakan: The most important thing for a student of engineering and technology to do is keep abreast of issues, because technology is changing very, very rapidly. There are new technologies being created. There are new processes being developed. Science is forever pushing back the frontiers of knowledge. It's very important for a student to keep abreast of things. Often, the things that are taught to students in their traditional core courses are things that have been already studied and have been well-established. And it's important for students to know that. But it's also important for them to keep abreast of the changes that are occurring in science and technology, and to see how those changes have an impact on their particular field. The second thing I think that's very important is to be aware of the different social, political, and economic issues that are current. They have a big impact on what types of technologies get pursued, on what types of research gets done, funded, and supported. It's important for students to be aware of what the currents are outside their discipline so that they can incorporate those into their thinking about how their career and their profession situate within the rest of the world.

Q: Are there frustrating aspects of your job?

Tharakan: The bureaucracy. About 20% of my time is spent on administrative matters. Things like getting the right form signed, by the right person, getting the right number of copies of that form made, and making sure that form gets to the office that it's supposed to. It can be extremely frustrating because it's something that you don't have any control over.

Q: Can you give an example of how you have applied your technical training?

Tharakan: When I worked in industry, I worked for the American Red Cross' blood services organization. What they're involved in is the production of various therapeutic factors by isolating them from human plasma. I was the second chemical engineer actually to join that industry. But the training that I had in the fundamentals of chemical engineering, such as separation processes, mass transfer, and thermal dynamics and equilibria, informed me and helped me to develop a process that eventually got patented for the purification of Factor 9, which is one of the proteins in your blood that is responsible for blood clotting. Hemophiliacs are people who lack Factor 9. One of the treatments is to give them supplemental Factor 9, which is obtained by purifying it from healthy people's plasma. I saw the development of that

as a direct outcome of the professional training that I had, not any spectacular insight or a light bulb going off in my head. But it was a really rigorous development starting from fundamental chemical engineering principles. My advice to chemical engineering students would be twofold. One is to get well grounded in the fundamentals of your field. If you're going to call yourself a chemical engineer, you have to know what chemical engineering is all about. And second, you have to be fairly well-read. It's not sufficient to be just a chemical engineer. I think it's important to be a well-rounded chemical engineer, and this means a chemical engineer who knows something about social and political issues, a chemical engineer who's aware of the different issues that govern the marketplace and economy. Awareness of these things outside one's field is very important for success as a chemical engineer.