

# Programs of International Study and Work for Engineering Students at the New Jersey Institute of Technology

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*The New Jersey Institute of Technology (NJIT) operates an NSF Industry/University Cooperative Research Center dealing with hazardous substances. The center is working with scholars in France, Ireland, and Indonesia to develop similar centers as a basis for research collaboration and exchanges of students and faculty. The Institute is developing an industry membership center to support opportunities for engineering students to work and study abroad. As part of its overall effort to create international educational programs, NJIT has signed collaborative agreements with foreign universities.*

## INTRODUCTION

UNIVERSITIES in the United States have for many years—since the end of the Second World War—created programs in which students could opt to spend a year studying at a university in another country. The preponderance of students participating in the Junior Year Abroad Programs are liberal arts majors. There are a number of reasons why this is so.

Liberal arts majors frequently have the flexibility in their schedule to arrange for a year of study abroad; engineering students do not. In the United States, engineering curricula are four-year programs. Yet a vast increase in scientific and technological knowledge has been discovered since the end of the Second World War. Thus, engineering programs have become compressed, with new material to be incorporated into the curricula in the same four year period. Also, the United States engineering accrediting agency, ABET, has strict guidelines about the content of an engineering education. It is difficult to comply with these guidelines and maintain the flexibility necessary to provide an international experience for engineering students.

Further, it is important to look at the way most engineering curricula are organized. In the first two years, attention is given to the scientific and mathematical underpinnings of the engineering students' education. Most curricula now contain some engineering content in the first two years, one or two introductory courses in the students' major. The junior year is the first year that the engineering student strongly connects with the engineering department, a difficult year to send students off to study overseas.

Liberal arts students, when they go to another

country in their junior year, need only organize their course of study from an existing array of courses so as to complement their course of study at the home university. In general, accomplishing this task is not difficult. For engineering students, establishing a course of study at an overseas university is much more complex because engineering curricula are far more rigidly structured to contain all the curriculum material, to assure a proper sequence of courses, and to meet all the accrediting requirements.

Finally, engineering curricula in the United States are often organized differently from those in most foreign universities. For example, in many foreign countries students emerging from their precollege studies are sometimes advanced one and even two years over US students who must close this gap during their baccalaureate years. Engineering programs in many countries are five-year programs which stress engineering science compared to four-year programs in the United States, which tend to stress application and design. These incompatibilities make it difficult for undergraduate engineering students to spend a period of time studying abroad.

In spite of the difficulties associated with implementing a foreign study program for engineering students, the value is great. Professional engineers are increasingly expected to work in an international environment and their companies' products and services are expected to have an international clientele.

The responsibility for preparing engineers for a global workplace resides in the university. Universities in the United States are beginning to offer programs of international study for engineering students. Currently the number and size of such programs is small but growing, even though the



total number of engineering students graduating each year in the United States with some international experience is still insignificant.

As a technology-oriented and growing university, New Jersey Institute of Technology (NJIT) has been building programs to help American engineering students gain a breadth of international experience. Relationships with universities in almost all areas of the globe facilitate faculty and student exchanges.

### RESEARCH-BASED PROGRAMS

In 1983, NJIT established a research center dealing with hazardous substances and industrial waste, a National Science Foundation Industry/University Cooperative Research Center (I/UCRC).

#### *The working model*

The I/UCRC model works in the following way: industrial firms are solicited to become members of the center by agreeing to pay a membership fee each year for a specific period of time. The fee is usually on the order of US\$30 000, and the expected commitment of time is usually three years before renewal. The center engages in pre-competitive research so that the industrial companies can collaborate without violating antitrust laws. An Industrial Advisory Board is comprised of representatives from the member companies. The board works with the Director of the center to establish research priorities and goals. A call goes out to the faculty for proposals along with a description of the research priorities and goals, and the Industrial Advisory Board acts as a peer review panel for these proposals. They make recommendations for funding, changes in individual proposals, and new collaborations. Although they act only to recommend actions to the Director, their recommendations generally have a powerful influence on the choice of research projects.

### THE FRENCH RESEARCH CENTER

Several years ago, the scientific attaché of the French Embassy in Washington began a search in the United States for innovative and successful models of collaborative environmental research between industry and the university. He hoped to establish a relationship with a successful US institution and a similar organization in France. He considered the NJIT research center model to have the potential for success in France, so he took steps to arouse French interest in developing a similar program. Coincidentally, his effort coincided with plans at NSF to develop linkages along US Industry/University Cooperative Research Centers and similar centers in other countries. It was decided that the Institut National Scientifique de Lyon (INSA) would serve as the organizing point because they already were engaged in a

vigorous environmental research program in France, involving industry to some extent.

Differences in law and culture prevented the creation of a duplicate center in France: in the US the member companies enjoy tax credits associated with their membership fees, whereas in France this is not so. A patent ownership and licensing agreement was easily reached in the US, while in France, it was much more difficult because French universities can neither own patents nor give licenses. Thus, an industrial corporation was created with all the member companies acting as partners. This corporation became the research center and a legal entity with research contracted out to universities. This organizational structure has the benefit of not being officially associated with a single university. It can establish contracts with any French academic organization which substantially extends the size of its expert pool.

### COLLABORATION WITH INSA

The center at INSA currently operates as a collaborative center. NJIT and INSA representatives meet regularly to identify overlapping research interests and faculty expertise. Three areas have been identified: thermal treatment and biological treatment of industrial waste, and solidification of hazardous materials. Researchers from the US and French centers are currently developing joint research programs in each of these areas. Funding for the collaborative research is being sought in the US from NSF and in France from an equivalent agency. The funding program mandate is to advance the scientific/technological state of the art, and to promote exchanges of faculty and students. As a consequence researchers on both sides of the Atlantic will be familiar with research work at each center, thus fostering additional future collaboration.

At this time, two French post-doctoral students have spent a year at the NJIT center, and three students from INSA have studied at NJIT for a Master's Degree in Environmental Engineering.

### COLLABORATION WITH THE QUEENS UNIVERSITY RESEARCH CENTER

A second similar collaboration has taken place between the NJIT Hazardous Substance Management Research Center and The Queens University Environmental Science and Technology Center (QUESTOR) in Belfast, Ireland. QUESTOR is based on a design very similar to that of I/UCRC. A collaborative joint effort is funded by the NSF and a comparable agency in Ireland. Two students from Queens came to the NJIT center to learn about our approaches to certain classes of problems in the absorption of materials and biological treatment.

NJIT's long-term goal is to develop more of an exchange and, more importantly to set up a colla-



boration of European Community universities so that we and they can more readily find a match of expertise and interest.

#### *The partnership for education/program*

In the Spring of 1991, NJIT submitted a proposal to the National Science Foundation to support the establishment of a science and engineering partnership between the Hazardous Substance Management Research Center and the University of Indonesia. The United States interest in such collaborations was expressed in July 1990 when former Secretary of State James Baker announced the establishment of the US-supported APEC Partnerships for Education. APEC or the Asia-Pacific Economic Cooperation is comprised of the major Pacific Rim countries, and is intended to provide a forum for multilateral dialogue on matters of interest affecting the Pacific Basin. Secretary Baker charged the US Agency for International Development (AID) with the responsibility for developing the program. The Partnerships are intended to foster educational collaborations between US and other APEC academic institutions; to support outreach for US students, and to encourage private sector participation in training.

To accomplish its mission, AID is working with the I/UCRC program at NSF. The NJIT University of Indonesia program is sponsored by the Partnership for Education program through the NSF.

The ultimate goal of the program is to help the University of Indonesia establish an I/UCRC which will conduct joint research projects with the NJIT center. This goal, however, is a distant one for a number of reasons. First, Indonesian industry is not accustomed to working with universities. Second, much of Indonesian industry is established as a turnkey operation. A working facility is put in place by others; the workers merely run the plant, and cannot repair malfunctions, shutting down the plant until qualified outside personnel repair the system. This model is inefficient and results in low productivity.

NJIT, advised by their colleagues in Indonesia, have opted to focus on the textile industry, because it is both a major industry and a major polluter. The NJIT team is working with faculty from the University of Indonesia to develop personnel training and educational programs at the textile plants to help them understand the processes and the factors that influence them. The goal is to develop trained technologists who can participate in modifying plant processes to minimize waste, thereby, increasing efficiency and productivity.

Technical personnel from the US textile industry are also participating in this program. It is anticipated that after the project is in place for a period of time, the Indonesian faculty and local industrial representatives will assume the major responsibility for training. Also, it is intended that this effort will result in Indonesian industry recognizing that co-operation with universities can result in substantial advantages for them. It is only after such

recognition that NJIT and the University of Indonesia can successfully undertake the establishment of an I/UCRC.

#### *Other collaborations*

NJIT is in the early stages of working with the NSF under the Partnerships for Education Program to create an I/UCRC in the Philippines. The long-term goal in the region is to create a number of regional centers and network them with the NJIT Hazardous Substance Management Research Center to provide a research base in the regional universities to support local industry.

### **EXCHANGE COLLABORATIONS WITH FOREIGN UNIVERSITIES**

A second category of international collaboration involves the identification of institutions which are similar to NJIT in curriculum structure and length, and in language in an attempt to organize specific exchange programs.

To set up such relationships and to establish a foundation of support for NJIT's international efforts, the university is creating a Center for International Education and Training, which will develop opportunities for students to have short duration international experiences for a summer or an intercession, or long duration experiences, lasting an academic or calendar year. These experiences will take place in university and industry settings overseas.

#### *NJIT Center for International Education and Training*

The establishment of this center is based on the membership model of the Industry/University Cooperative Research Centers. Industries are being asked to become members of the center for a term of five years. The membership fee is based on the cost of tuition for one student for one year plus an administrative fee. Funds will be made available to support students to study or work overseas for a summer or during the January intercession period. However, the main thrust of the center is in mounting international exchange programs of academic or calendar year duration. For these long-term programs freshmen will be recruited who have achieved high SAT scores and are at the top of their high school class. For the first two years of their education they will be given a partial scholarship. At the end of the second year the student and the member companies will mutually interview and select each other. Subsequent to the second year the students will be on full scholarship sponsored by the selected company. Following the completion of their degree requirements, the students in the program will be obligated to work for the sponsoring company for two or three years depending on the number of years of corporate support.

Depending on the program these students elect



to enter they will spend either an academic or calendar year at an overseas university. NJIT expects to develop four-year programs leading to a baccalaureate degree and five-year programs leading to a Master's degree. Packaged together with these international components will be NJIT's existing co-operative education and international co-operative education programs.

#### UMBRELLA AGREEMENTS WITH FOREIGN UNIVERSITIES

NJIT has signed more than twenty collaborative agreements with universities in other countries. These agreements are intended to promote exchange programs among students and faculty and research collaborations. In general, such umbrella agreements only lead to programs when a person at one or the other institution develops a personal interest in the collaboration.

NJIT has signed collaborations with universities in Turkey, Russia, the Ukraine, Armenia, India, Germany, Egypt, the Peoples Republic of China, and Korea. As a result of these agreements NJIT has hosted 30 Russian students to study English as a second language; 10 additional Russian students to attend a series of specially designed lectures on a free market economy; 13 graduate students; 3

visiting professors, and the appointment of 5 NJIT faculty as visiting professors to one of the institutions with whom we have an umbrella agreement.

#### PROGRAMS BASED ON SPECIAL EXPERTISE

NJIT is involved in several programs because of the special expertise of its faculty. The government of the Ukraine is working with a coalition of industries, and one university to help them clean up the environmental contamination left by the Chernobyl disaster. As part of this coalition, NJIT's responsibilities are to train managers and technicians in the art of cleanup, to teach environment-related courses, and to develop a teaching program concerned with the free market operation of businesses and competitive practices. NJIT will train members of Ukrainian academic institutions who will then become providers of this education to business people in their country.

For several years, faculty members from NJIT's Center for Transportation Studies and Research have been involved in a program with the Peoples Republic of China in which approximately 30 Chinese students come to NJIT for six weeks to take an intensive series of courses in transportation management and transportation systems.

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