UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Provost and Vice Chancellor
for Academic Affairs

Swanlund Administration Building
601 East John Street
Champaign, IL 61820

September 6, 2001

Susan A. Lamb, Chair
Senate Committee on Educational Policy
Office of the Senate
228 English Building, MC-461

Dear Professor Lamb:

Enclosed are copies of a proposal from the Department of Chemical Engineering for a Singapore Study Abroad Option in the Master of Science in Chemical Engineering.

This proposal has been approved by the appropriate College committees and the Graduate College; it now requires Senate review.

Sincerely,

Keith A. Marshall

Keith A. Marshall
Assistant Provost

KAM/drm

c: C. Livingstone
C. Zukoski

PROPOSAL FOR

SINGAPORE STUDY ABROAD OPTION IN THE MASTER OF SCIENCE IN CHEMICAL ENGINEERING

SPONSOR

C. F. Zukoski, Department of Chemical Engineering, 114 Roger Adams Laboratory, Box C-3, 600 S. Mathews Avenue, Urbana, IL, 61801; 217-244-9214; czukoski@uiuc.edu

BRIEF DESCRIPTION

The Singapore Study Abroad Option will allow students to take up to half of their master's course work at the National University of Singapore and complete two intensive industrial internships—one in Singapore and the other in the U.S.—as part of their master's program.

Students will complete one semester of course work at UIUC and one semester at the National University of Singapore. For the Singapore portion of their course work, students will select from a list of NUS courses approved by residence credit. In addition, students will complete two extensive industrial internships, each of 3-4 months duration.

Requirements for the Option differ from current requirements for the Master of Science degree in this way: In lieu of a thesis, students in the Option will take one additional unit of course work (for a total of six units of course work required) and present extensive project reports on their two internship experiences.

JUSTIFICATION

The Department of Chemical Engineering is interested in offering its students significant opportunities to work in global settings and in applied research. This option is designed to introduce students to the field of chemical engineering as practiced internationally, and is intended to ready new engineers for the global marketplace, which is important career preparation regardless of where employment is ultimately obtained.

The Department of Chemical and Environmental Engineering at the National University of Singapore is a leading institution in the Asia-Pacific region. The department has about 780 undergraduates, 410 graduate students, and 47 highly qualified academic and staff members. The department maintains strong links with industry and places many students in industry through their internship programs. Supervision and evaluation of the industrial component of this program while students are in Singapore is very similar to what the NUS faculty routinely and successfully do through other programs. The undergraduate program offered by NUS is accredited by the Accreditation Board for Engineering and Technology (ABET). Review of the NUS academic program has been carried out by visits of 4 UIUC faculty to NUS. The proposed program of study leading to the degree of Master of Science through the Singapore Study Abroad Option is scheduled to be reviewed every three years.

BUDGETARY AND STAFF IMPLICATIONS

a. **Additional staff and dollars needed.**

The cost of this program will be born by the industrial and Singapore governmental sponsors.

b. **Internal reallocations (changes in class size, teaching loads, student-faculty ratio, etc.)**

The proposed Option will enroll a maximum of 10 students each year. A program of this modest size can be fully accommodated within the Department's existing instructional and advising resources.

c. **Effect on course enrollments in other departments and explanations of discussions with representatives of those departments.**

None

d. **Impact on library, computer use, laboratory use, equipment, etc.**

None, given the small size of this program

GUIDELINES FOR UNDERGRADUATE EDUCATION

Not Applicable

CLEARANCES

[signature]	8/31/01
Department/Unit Head	Date
[signature]	8/31/01
School Approval (if applicable)	Date
[signature]	8/31/01
~~Assistant~~ Associate Dean, College of Liberal Arts and Sciences	Date
[signature]	August 31, 2001
~~Dean~~, Graduate College	Date
Assoc. Provost	Date

STATEMENT FOR THE BULLETIN

Current statement in the 2001-2003 Programs of Study catalog:

Master of Science

Requirements for the master of science include eight units of graduate credit and a thesis. At least five of these units must be in courses other than thesis research with a minimum of three units in 400-level courses; two of the 400-level units must be in chemical engineering courses. Thesis requirement may be waived in special circumstances, and in such cases, no credit is given for registration in thesis research.

Following statement will be added:

Study Abroad Option. This option requires completion of six units of graduate non-thesis credit and allows students to complete up to half of the required units at the National University of Singapore. Courses taken in Singapore are selected from an approved list and must include at least two courses that have the CN prefix. At least two of the courses completed at UIUC must be 400-level courses in chemical engineering. In lieu of a thesis, students complete two industrial internships—one in Singapore and one in the U.S.—and present two substantial project reports based on their internship experiences.

EFFECTIVE DATE

January 5, 2002

Appendix:

List of currently approved NUS courses.

CN5001-Process Modeling and Optimization
CN5002-Mathematical Methods in Chemical and Environmental Engineering
CN5101-Advanced Separation Processes
CN5201-Advanced Reaction Engineering
CN5202-Electrochemical Systems and Methods
CN5203-ULSI Technology
CN5204-Pharmaceuticals and Fine Chemicals
CN5301-Advanced Chemical Engineering Thermodynamics
CN5302-Surfaces and Colloids
CN5401-Advanced Transport Phenomena
CN5402-Two-Phase Flow and Fluidization
CN5403-Viscoelastic Fluids
CN5501-Advanced in Multivariable Controller Design
CN5502-Distillation Dynamics and Control
CN5601-Advanced Polymeric Materials
CN5603-Membrane Separation Technology
CN5604-Polymer Processing Engineering
CN5701-Project Engineering
CN5901-Selected Topics in Chemical Engineering-I
CN5902-Selected Topics in Chemical Engineering-II
EV5102-Water Pollution Control Technology
EV5104-Air Pollution Control Technology
EV5202-Quantified Risk Analysis
EV5203-Environmental Impact Assessment and Auditing
SH0004-Fundamentals in Industrial Hygiene
SH0011-Hazard Identification and Evaluation Techniques
SH0014-Safety Engineering
SH0017-Industrial Hazardous Waste Control

Substantial Equivalency Evaluation[1]

of the

Program in Chemical Engineering at The National University of Singapore

January 5-8, 1999

Statement to the Institution[2]

Robert R. Furgason, Team Chair
Robert A. Greenkorn, Program Visitor
John W. Prados, Program Visitor

At the invitation of the National University of Singapore, the Accreditation Board for Engineering and Technology (ABET) conducted an evaluation of the university and its Chemical Engineering program using ABET's substantial equivalency evaluation procedures for international institutions. Although the policies and procedures used for this evaluation parallel the accreditation of U.S. engineering programs, ABET does not formally accredit programs beyond the U.S., but does validate whether the programs are substantially equivalent to U.S. accredited programs. In this context, "substantial equivalency" means that a program offered by a university outside of the United States is comparable in all material aspects to an accredited U.S. program and that the current state of the program is judged to meet the general and program-specific ABET minimum requirements for a program of that type, implying reasonable confidence that the graduates of the program possess the competencies needed to begin professional practice at the entry level in Singapore.

[1]The policies and procedures used for the visit followed those described in the October, 1998 version of "Policies and Procedures for ABET Substantial Equivalency Evaluations," and the 1998-99 edition of ABET's "Criteria For Accrediting Programs in Engineering in the United States."

[2]With regard to this written statement, ABET policy requires that unless institutional policy or governmental laws require it, direct quotations from the written statement are not authorized. Whenever institutional policy or governmental laws require release, the entire document must be released.

Acknowledgments

The ABET evaluation team expresses its warmest thanks to Vice Chancellor Lim, Deputy Vice Chancellor Hang, Dean of Engineering Low, and the Department Head K.G. Neoh as well as the engineering faculty, students, and administrative staff who met with the team members and discussed the chemical engineering program, supporting academic areas, and other services. The support provided to the team throughout the assessment was very well organized and helpful. The self-study documents, describing the University as a whole and the educational program in chemical engineering, augmented by the on-site observations, served as the basis for the evaluation. The documents and materials presented were very informative and well done.

The evaluation team recognizes that the *ABET/EAC Criteria* used for this assessment are primarily based upon the U.S. system of engineering education and practice, and may not be entirely applicable to the educational system of every country. The evaluation is sensitive to such differences and these are taken into account in the process. However, the basic criteria and intent of the evaluation system widely apply to engineering educational programs worldwide.

General Observations

Vice Chancellor Lim well described the basic development plan of Singapore. This involves the goal of having the country be a focal point for high technology and the educational development of the citizens of the country as well as attracting talented individuals from throughout the world. Since it is a country of very limited geographical area and consequently of few natural resources, it logically looks to its people resources to be the driving force for the future. Thus, the National University of Singapore is a very important component in the development strategies of the country.

Deputy Vice Chancellor Hang provided a detailed presentation on the overall characteristics of the university and its objectives with regard to both the educational and research programs. The roles of the various research institutes were outlined and how these entities related to national and university strategies.

Dean of Engineering Low gave further details on the activities of the various departments and programs within the Faculty of Engineering. His experience in directing one of the major research institutes of the university provides him with a unique perspective in guiding the programs to be responsive to the national needs as well as the trends and changes in engineering education world-wide. His attempts to streamline the administrative structure and duties within the faculty appear to be well directed and appropriate. When fully implemented, such changes should alleviate many of the concerns of the faculty members and others related to their administrative responsibilities and burdens.

In general, it appears that the government of Singapore supports the National University of Singapore very well compared to most publicly supported universities. The facilities are relatively modern and well maintained. There seems to be a sense of commitment to make the NUS a highly respected internationally recognized university. This goal is being vigorously pursued. Even though the current economic status of Asia is undergoing significant stress, the budgets of the university have not been significantly affected.

The engineering programs are a major part of the university's offerings and important to the university and country. The Singapore government, through such entities as the Ministry of Education, the Economic Development Board and the National Science and Technology Board, provides both guidance and support for the university and its programs. This system establishes a close working relationship between the governmental agencies and the departmental programs.

The engineering facilities are quite adequate and involve mostly modern laboratories and equipment, although the increase in engineering enrollments has caused some crowding and limitations on equipment. The completion of facilities under construction and the renovation of vacated space will be a definite relief in this respect.

The students and faculty of the university have access to impressive computer facilities and networks. The University's Computer Centre, the Super Computing & Visualisation Unit, and the CAE/CAD/CAM facilities provide an excellent foundation for information technology access and computational power. In addition, many departments have dedicated computer laboratories and PC access for students. These types of facilities are essential for modern instructional programs in technological areas.

The NUS library system, consisting of six individual facilities, is very good and provides excellent access to a wide array of information both locally and through the Internet. The holdings are certainly adequate for the undergraduate engineering programs that would undergo accreditation evaluation through ABET. Most of the journals and monographs that engineering faculty and graduate students would need are available or are being acquired at a reasonable rate. The library is striving to be responsive to contemporary needs of the students and faculty through such developments as the areas equipped for individual laptop computer stations that can access the library electronic systems. The faculty and students seemed to be quite content with the library services they receive.

The faculty salary structure appears to be competitive to attract a high quality faculty member. The ability of the university to support the faculty member for the entire calendar year is commendable and is of value in attracting and retaining notable faculty. The bonus system adds to the total compensation amount and makes the total salary even more attractive. Combined with the ability of the university to support research activities internally, the compensation structure should put NUS in a relatively good competitive posture for faculty members; however this is dependent on the local cost of living.

The issue of administrative responsibilities of the faculty is a continuing concern of the faculty and departmental administrators. Having the faculty involved in some administrative functions is helpful in having them understand and participate in the overall activities of the institution. However, too many such assignments, particularly committee activities that might be better handled by administrative staff, tend to distract from the primary contributions of the faculty, mainly their teaching and research programs.

The admission criteria for entrance to NUS, particularly its engineering programs, are quite rigorous, thus contributing to a well-qualified student body.

The fact that the engineering programs have sought accreditation or recognition from external groups such as the Institution of Chemical Engineers (IChemE), UK is a positive indication of the commitment of the government of Singapore as it looks to the National University of Singapore to be a major component in its strategies for development. The utilization of an International Advisory Panel also is a very good process to assure the department and university that its programs are consistent with international expectations and standards. The independent assessment made by the ABET evaluation team reaffirms most of the comments and suggestions of the IAP, and those of the reaccreditation report of IChemE.

Chemical Engineering Program

Faculty

The Chemical Engineering Department at NUS is undergoing a dramatic increase in size due to a planned increase in the number of undergraduate students from 110 in 1993/94 to 200 per year. Also, an environmental engineering program has been added to the department. (The environmental engineering program was not reviewed.) The total number of faculty at the time of the review was 42 including the environmental engineering faculty. The chemical engineering program is taught by 34 of the total faculty. Twenty-six faculty members were interviewed individually by members of the visiting team. Those faculty interviewed were for the most part enthusiastic about the program and the changes that are occurring. They currently have relatively heavy teaching loads and are cramped for space but realize this will improve with new faculty hires; 26 new positions have been approved for the department of which 16 are designated to be in chemical engineering. Also additional space will become available when the new building under construction is finished.

All of the faculty members interviewed are well educated – all have the Ph.D. degrees from reputable institutions mainly in the U.S. or the U.K. Many of the faculty members have post-doctoral experience and/or industrial experience. Several have taught at other institutions. The faculty appears to be proficient in English – the language used in instruction. The department has a policy of rotating the faculty assignments so they can obtain teaching experience in all of the required undergraduate courses. However, it is apparent that currently most are teaching courses related to their areas of research interest.

The faculty appears to have adequate publications; however, the publications of the younger faculty members are primarily related to their Ph.D. dissertation research. Professional registration is not important to the faculty. Each faculty member is supported to attend one overseas meeting and one meeting in the local area each year. A relatively large fraction of the faculty has been at NUS a relatively short time (22 of the 42 faculty members reported in Volume II of the Self-Study Questionnaire have less than five years at NUS). They are young and enthusiastic. How well the new faculty will perform and capitalize on the opportunities offered by NUS will become more apparent in the next several years.

Since a large majority of the current faculty have been at NUS less than five years it is difficult to comment on stability and continuity. With the large number of new faculty there is obviously a large flux in continuity – teaching new courses, beginning research programs, getting to know the system and the students. Although there is not a high turnover in personnel, the transition to a larger student body, and the addition of new faculty and a new program will naturally create a certain lack of stability and continuity. Currently, this does not appear to be impacting the morale of the faculty and the faculty appears to be working together effectively.

The large student enrollment increases have resulted in the student/faculty ratio increasing to 20/1 although the department goal is 13/1. With the proposed additions, this smaller goal can be reached. Each faculty member mentors a proportional number of students ~14 and interacts with students in the laboratories. Also, each faculty member directs from 2 to 4 students each semester in their undergraduate research report. Apparently there are several part-time faculty – members of local industry – who participate in teaching both core and elective courses. The team did not meet any of the part- time faculty members.

Current faculty loads are relatively heavy with about 15 contact hours per week common for each faculty member. Typical teaching loads require 3 lectures, 8 tutorials and lab direction for each faculty. Those faculty members teaching elective courses or trailer courses with smaller student numbers are given additional laboratory responsibilities. Teaching assignments appear to be adjusted so everyone has an equivalent load. Because of these loads it may be the faculty are not interacting with the undergraduate students as much as desirable. Although there is some shift from a single course grade based on a final exam to continuous assessment, the preparation and grading of the comprehensive final also creates additional faculty load.

Faculty members each act as mentors for about 14 students advising them about course work and professional activities. Career guidance is mostly limited to availability of jobs in Singapore. Although there appears to be jobs available, they are not always the first choice of the students thus the students need to receive encouragement and guidance for job selection. The faculty are also engaged in curricular revision.

In summary, the Chemical Engineering Department has a large competent faculty that has been increasing dramatically in numbers. They appear to have the necessary qualifications for adequate scholarship. The faculty backgrounds are diverse. The faculty has reasonable interaction with the undergraduate students. The stability and continuity are not that of a department in steady state so care must be taken during the transition. Teaching loads are heavy since the number of faculty available is not up to the planned number required to teach the increased student numbers. Further transition from the U.K. system to the U.S. system can cause additional dynamics.

The facilities currently are crowded due to the increases in students and faculty. The faculty offices are adequate, as are the classrooms. Laboratory space is currently crowded. However, in the near future the department will obtain more space in the new building under construction. The senior laboratory will be moved and improvements planned.

Students

Students admitted to the chemical engineering program at NUS are well qualified academically. Although some alternative admission requirements exist, the great majority have passed the Singapore Cambridge General Certificate of Education Advanced Level Examinations in the following three areas:

- chemistry at the A-level
- mathematics or pure mathematics or further mathematics at the A-level
- physics at least at the O-level (taken at the A-level examination)

This strong preparation is reflected in strong student performance in demanding courses at NUS.

Students were interviewed in two groups: ten first- and second-year students, and ten third- and fourth-year students. Students expressed general satisfaction with their educational experiences at NUS. They felt that they had adequate access to laboratory, computer, and library facilities, and that the chemical engineering faculty members were accessible and willing to help them outside of class as needed.

Discussions with faculty and examination of samples of student work indicated that the great majority of students are very bright and hard working. However, it appears that their pre-college educational experiences have conditioned them to expect well-defined assignments with single correct answers and examinations that emphasize rote information recall. This type of learning does not prepare students well for the innovative technical leadership needed by engineers and their employers in today's global competitive environment. The visiting team recognizes that the chemical engineering faculty has been working to address this issue through introduction of open-book examinations along with a significant number of open-ended problems and projects throughout the curriculum, especially in the unit operations course. The faculty is encouraged to extend these efforts to other courses, particularly the laboratories where the majority of experiments appear to be of the well-defined, "fill-in-the-blanks" format. More open-ended laboratory experiences could help reinforce the needed culture change beginning early in the students' program of study.

In the current job market, NUS chemical engineering graduates appear to be finding suitable employment without difficulty. Those choosing to pursue graduate study have been admitted to

leading chemical engineering graduate programs in Europe and the United States.

Curriculum

The chemical engineering curriculum appears generally strong and well designed to develop the needed technical competence and intellectual skills in graduates. The level of mathematical sophistication is higher than that found in many chemical engineering programs in the U.S. Curricular objectives, as articulated in the program self-study, appear to be in keeping with overall institutional goals, the student body served, and the needs of the region's employers of chemical engineering graduates.

The curricular distribution conforms, in most respects, to the requirements of ABET engineering criteria. The proportions of the curriculum devoted to mathematics and basic sciences and to humanities and social sciences are slightly below those specified by the criteria, but these are not seen as deficiencies in view of the students' broad, pre-university general education. In particular, competence in mathematics, chemistry, and physics usually covered in the first year of U.S. engineering curricula is verified through entering students' performance on the Cambridge A-level examinations. Many advanced calculus topics beyond ordinary differential equations are introduced in the engineering mathematics course, and assignments in numerical methods, probability, and statistics are also required. Although, the coverage in advanced chemistry may appear to be somewhat below that expected in U.S. chemical engineering curricula, but this is not judged to constitute a significant deficiency. NUS students receive a more advanced general chemistry background (Cambridge A-level) than is typical in the U.S., and appropriate chemistry topics are included throughout the curriculum. The organic and physical chemistry laboratory experience is more extensive than in many U.S. programs, and the required course in materials science is an appropriate advanced science.

Engineering topics, including the chemical engineering sciences specified in *Chemical Engineering Program Criteria*, appear to receive adequate attention. Fourth-year elective courses allow some degree of specialization in areas of importance to engineering employers in Singapore. The use of industry-based projects for the fourth-year capstone design experience, and the opportunities for students to interact with engineers from industry in their design projects, is particularly commendable. The design projects are conducted by six-student teams, and the results are documented in a written report. The visiting committee suggests that it might be worthwhile to consider adding a requirement for oral presentation of design project results to the faculty, students, and the industry contact. Also, as suggested in the section of this report dealing with students, the visiting committee encourages additional efforts to increase the students' experience with open-ended problems earlier in the curriculum in order to prepare them more effectively for their fourth-year design projects.

A significant component of the NUS chemical engineering curriculum is the requirement that each student complete a six-month Industrial Attachment jointly directed by a faculty member and an engineer from industry. These usually occupy the second semester of the third year or the first semester of the fourth year. At the time of the visit, approximately 70-80 students were fulfilling the Industrial Attachment requirement at any given time, but this will increase to approximately 100 with the planned increase in enrollment. About 40 employers are involved in a given semester. Usually 5-6 students will complete their Industrial Attachments abroad; generally the top students selected by their employers for overseas assignments. Students may bring back ideas from their Industrial Attachments to use as a basis for their fourth-year research projects, a practice that deserves encouragement.

A second significant curricular component is the research project required of each student during the fourth year of the program. These projects are proposed and directed by faculty, and the results are presented orally and documented in a written report. Faculty members indicate that they attempt to make these projects open-ended, but that most students resist these efforts and seek close guidance of their work. The ABET evaluation committee strongly encourages the faculty to continue its efforts to provide more open-ended research experiences.

Computer-based experiences in the curriculum are well supported by a number of computer laboratories providing access both to personal computers and high-end workstations. Students take an introductory course in computer applications and make use of computers in subsequent chemical engineering courses, especially unit operations and design project. Integration of computer methods in traditional engineering science courses appears somewhat uneven, and faculty members are encouraged to continue development of more computer-based student experiences in such courses.

Laboratory experiences, both in engineering and in basic sciences, appear appropriate. However, as noted in the section of this report dealing with students, the visiting committee suggests that the experiments be presented to students in a more open-ended format, rather than the "fill-in-the-blanks" instructions currently provided, in order to encourage broader, more innovative thinking early in the students' educational experiences.

The curriculum includes a strong component in communications. Unless exempted by examination, students are required to take a first-year English course. All students take two courses in technical communications that emphasize both written and oral communication skills. Communication skills are reinforced through the laboratory, design, and research project experiences. Several examples were observed where design and laboratory reports were corrected for English usage as well as technical content.

Economic and safety considerations in chemical engineering practice are introduced in courses in economics and chemical plant safety and reliability, and are reinforced through the design project. However, the curriculum appears to contain no formal introduction to professional ethics. Understanding the ethical and social responsibilities of the engineer are an essential component of responsible professional practice, and the faculty is urged to develop either curricular or extra-curricular components of the students' experiences that will introduce and reinforce these concepts.

Facilities

The laboratory facilities are crowded but most of the experiments are excellent. Space for the senior laboratory is not as satisfactory as the other labs but this lab will be moved when the new building is finished. The senior laboratory experiments can be improved. Generally the laboratory experience is well organised and students have access to experiments that complement their classes. The experiments demonstrate principles learned in class. However, the experimental procedures should be changed so that the experiments are more open-ended and less routine in nature. There is need for additional space and additional experiments to accommodate the increase in students. A plan exists for future laboratory expenditures.

The computer facilities are excellent. There appears to be an adequate number of personal computers and work stations available for student and faculty use. Currently, computers are mainly used in the design courses and for research. Common canned programs are available for use in the computer center. The computer center has excellent facilities including a Cray supercomputer with vector processing. The computer equipment available is listed in Volume I, pages 21-29, Self-Study Questionnaire. The computer center appears to be service oriented to help faculty and students. It is anticipated that each student in the near future will have a laptop computer. Adequate ports are available for students to plug into the network. Currently, the major facilities in the computer center are used for undergraduate and graduate research projects.

Supporting Areas

Mathematics and Computer Programming

The initial calculus and linear algebra courses - A & B - are taught by the Mathematics Department. The two faculty members interviewed, Prof.'s. K. N. Ching, and R. C. Gupta, were enthusiastic about teaching chemical engineering students. They believed the students to be the best at NUS.

A programming course - FORTRAN 90 and JAVA - is taught to the chemical engineering students by a civil engineering professor, K. K. Ang. He is also enthusiastic about the chemical engineering students. This course is taught totally on a continuous assessment basis.

Organic Chemistry

Discussions with Professor S. Y. Lee of the Department of Chemistry confirmed that CN 1401 is a special course in organic chemistry offered for chemical engineering students. This required course consists of 26 lectures and 13 tutorials, lasting for one semester. Professor Lee delivers all the lectures and handles most of the tutorials himself. He also provides some of the lectures in CN 4211, Petrochemical and Processing Technology. He is well qualified for this role, having worked as a chemist for Exxon in Malaysia for five years before coming to NUS. In the tutorials, he emphasizes industrial applications of organic chemistry. Because of the large numbers of students in each organic chemistry class (now approaching 200), he is unable to address all questions personally in the tutorial sessions, but makes himself readily available via e-mail to answer questions.

Professor Lee was quite complimentary of the chemical engineering students; he stated that they are among the best in the university and that they have strong chemistry backgrounds before they begin the organic chemistry course.

The required organic chemistry course, CN 1401, appears to provide valuable support for the chemical engineering program.

Economics

Discussions with Prof. F. Chan of the Economics Department indicated that the introductory economics course, EG 1421, is taken by all engineering students and serves approximately 1,000 students per year. The course is offered in two lecture sections of approximately 500 each. Lectures are held once per week for approximately 1.5 hours and tutorials every other week with about 25-30 students per section. The course provides an introduction both to microeconomics and macroeconomics. Grades are based on a mid-term multiple choice quiz on microeconomics and a final examination consisting of a multiple-choice quiz on macroeconomics, two out of four quantitative problems, and two short essays on specified topics in economics.

Prof. Chan reported, surprisingly, that a number of engineering students have problems with the mathematical concepts required for economic analysis.

The required economics course, EG 1421, appears to provide valuable support for the chemical engineering program.

Technical Communications

Technical communications comprise two courses. The faculty involved, Prof.'s. Chan, Lopez-Nerney, and Wah, are enthusiastic about the chemical engineering students. They concentrate on report writing, using some multi-media, and on oral presentation. Since the first-year students do not have much of a technical background they would prefer to have the second course in the final year associated with the design project. It would seem that the students would benefit if the second course were given at the same time or with the design project.

Human Resource Management

Dr. Y. K. Chung and Ms. H. Loke were interviewed regarding the course in human resource management. The course is designed to help the students make the transition from academics to the industrial workplace. The focus is on communications skills, teamwork, motivation and other topics that are of importance in human relations. It appears to be an appropriate part of the curriculum.