

FLEXIBLE CURRICULA CAN BE STRONG

RAY FAHIEN
MACK TYNER
R. A. KEPPEL

*University of Florida
Gainesville, Florida*

UNDERGRADUATE PROGRAM IS DIVERSIFIED

There is much truth in the old story about the late G. G. Brown telling a questioner that "chemical engineering is what chemical engineers do." When asked what chemical engineers do, his reply was, naturally, that they do chemical engineering! But, contrary to the belief of certain narrow-minded persons, there is no single well-defined job that each and every chemical engineer does and which can be described as THE work of "THE chemical engineer." For in practice individual chemical engineers do numerous kinds of jobs each requiring different talents, abilities, and interests.

In spite of this great diversity of the profession, chemical engineering curricula have for years consisted of a rigid set of courses that every student was required to take. No consideration was made of his future career objectives, his personal interests, or his individual abilities. Although the typical curriculum might include perhaps two elective courses, these were often gleefully squandered in subjects such as bait casting, photography, or basket weaving. In view of our special nature as the only chemical engineering department in the State of Florida, we felt that we have special obligations to provide as broad a program as possible. *Accordingly, in 1965 we developed a curriculum that treated each student as an individual—one whose individual interests, talents, and career objectives could be expressed through a selection of option programs.*

The considerations that were involved in developing this curriculum are as follows:

First, we reaffirmed the belief that an engineering curriculum must be designed to prepare not only a broadly educated person but also train a professional man who could, upon graduation, do the kind of engineering work

that employers have associated with chemical engineering. Both of these educational objectives had to be fulfilled in four years since a five-year program has never been accepted by students, educators, or industry. However, it seemed neither possible nor desirable to devise a *single* four-year program that would prepare the student for *all* the various kinds of work that chemical engineers do. For it seemed wrong to subject the practice-oriented student to intensive theory and mathematics that he would not use; and it seemed equally unproductive of human talent to deprive the science-oriented student of that kind of experience that would best prepare him for graduate school and a career in research.

Second, we felt that it is essential that all programs in a chemical engineering department include those fundamental and core courses required for the practice of chemical engineering and that no program should be "watered down" so as to become an easy path to a cheap degree.

Third, we considered it important that a student not be unduly harmed by a wrong decision as to the program he chooses to enter. Therefore we made the differences between programs only about 10%. Actually since we require 213 quarter hours (142 semester hours) for a bachelor's degree, more leeway was possible than in schools requiring much fewer hours.

Fourth, we felt that a student should not be forced to make a decision until his senior year so that he is experienced and mature enough to make a wise choice.

Fifth, we believed that the option programs should not be so rigid that a student is prevented from substituting, when his reasons are sound, certain courses in the options for other courses.

The above general considerations were employed in the development of specific programs as follows:

Chemical engineering science option. Throughout the country a strong trend has developed toward a chemical

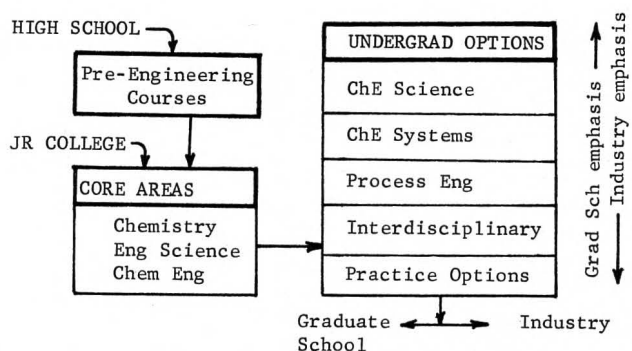


Figure 1. Flow Sheet for Undergraduate Options.

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engineering science program that primarily prepares a student for graduate work and for a career in fundamental research and teaching. Although a large majority of our students go into industry we felt that our department should have such a science-oriented program available in order to provide (nevertheless) an alternative for the student who might otherwise go into the engineering science program available in the College of Engineering. We call this program our *chemical engineering science option*.

Operations, business, and technical sales options. Many of our students obtain jobs in operations and eventually in middle management where theoretical and mathematical tools are not as much needed as by the researcher. Programs for such students were designed for industrial employment or further study in business, marketing, or law. These were called the *operations options* and *business options*. A modification is available for students interested in careers in *technical sales*.

TABLE 1 — CORE AREAS

Engineering Core	Chemistry Core	Chemical Engineering Core
Computer Model Formulation*	Organic Chemistry	Thermodynamics*
Intro. to Elec. Eng.	Organic Chem. Processing*	Transport Phenomena*
Statics	Physical Chemistry	Chemical Kinetics*
Strength of Materials	Instrumental Analysis*	Systems Analysis*
Materials of Engineering*		Solid-Fluid Systems*
Engineering Statistics		Control Theory*
		Stagewise Separations*
		Cost Estimation*
		Process Design*

*Taught in ChE department.

Process engineering option. Many students actually do not know what they want to do after graduation. As a result, chemical engineering curricula have traditionally attempted to produce a highly versatile chemical engineer—one that can easily start his career in any of many work assignments. We felt a program of this type should be retained. We called this option *process engineering* but upgraded it by the addition of transport phenomena, computer modeling and applied math courses.

Systems engineering option. The systems engineering approach is as much a part of chemical engineering as any other field of engineering, including that taught in systems engineering departments. Chemical engineers are bringing the fruits of automation to the process industries through the effective use of computers, mathematical models and processes, and advanced hardware to the design and operation of chemical complexes. Consequently we developed a computer-oriented *systems engineering option* in order to fill this need and also as an

TABLE 2A — SUBJECTS STUDIED IN APPLIED SCIENCE OPTIONS

	Process Eng.	ChE Systems	ChE Science
Reactor Dynamics and Design	*	*	*
Math Models in ChE	*	*	*
Technical Electives	*	*	*
Process Optimization		*	
Applied Molecular Theory			*
Advanced Process Design	*		
Ind. and Systems Eng.		*	
Applied Math Electives			*
Polymeric Materials	*		
Process Economics	*	*	
Tensor Fields and Fluid Dynamics			*
Quarter Credits in Option	22	22	22

alternative to the student who might otherwise enroll in the systems engineering program taught in the College of Engineering.

Interdisciplinary options. Some students have a difficult time choosing between chemical engineering and a "glamorous" field such as aerospace or nuclear engineering. At the same time the challenging problems of today tend to be coupled interactions between the application of engineering principles and the socio-economic needs of our society; e.g., pollution abatement, food production and/or population control. The inter-disciplinary options permit the chemical engineer with paralleled interests in other fields to take his degree in chemical engineering while at the same time studying 22 hours of approved courses in related disciplines such as aerospace engineering, environmental engineering, nuclear engineering, food science, or biomedical engineering. The latter program is approved for direct entrance into medical school.

Humanities or Liberal Studies. Many students today are concerned about the social problems of our society, about man's obligation to his fellow man and himself,

TABLE 2B — INTERDISCIPLINARY OPTIONS

Chem-Aerospace	Chem-Biomedical
Propulsion	Zoology
Aerodynamics	Biology
Chem-Electrical	Chem-Environmental
Electronics	Waste Treatment
Control Systems	Special Topics
Chem-Food Science	Chem-Materials
Chem. Principles	Elect. Properties
Eng. Principles	Corrosion
Chem-Mechanical	Chem-Nuclear
Turbines and Jets	Nuclear Tech.
Refrigeration	Nuclear Chemistry

TABLE 2C — PRACTICE OPTIONS

Operations	Business & Sales	Humanities, or Liberal Studies
Corrosion or Electrochemical Engrg	Report Writing Speech Courses Management	Political Science Sociology History
Polymeric Materials Management	Electives Marketing Electives	English Philosophy Religion
Electives Process Economics ChE Electives	Process Economics ChE Electives	Foreign Languages Process Economics ChE Electives

about values and ethics, and about the meaning of life itself. Therefore we developed a group of courses in the humanities and social sciences that would permit an engineering student to obtain a degree that was perhaps, because of its science content, more of a "liberal studies" program than that offered in the College of Art and Sciences.

GRADUATE PROGRAMS IN SCIENCE AND SYSTEMS

While some graduate students intend to teach and do basic research, many others are interested in industrial careers in development and design. Consequently the graduate program in the department was divided into three main areas:

(1) **Chemical Engineering Science:** transport phenomena, fluid dynamics, thermodynamics, kinetics, microstructure of matter, and materials science; (2) **Chemical Engineering Systems:** chemical reaction engineering, process control, process dynamics, optimization, separations processes; and (3) **Interdisciplinary Chemical Engineering:** energy conversion and fuel cells, polymer science, microelectronics, process economics, and bioengineering.

Master of Engineering with Project

There are four graduate programs in the department. These are: 1) the 45 quarter-hour Master of Science in Engineering program with thesis; 2) the 50 quarter-hour Master of Engineering pre-PhD program; 3) the 50 quarter-hour Master of Engineering terminal program with a project (which can involve a design, a cost analysis, an experimental investigation, a computer study, or a technical report); 4) the PhD program. Transfer between programs is possible within limits.

PhD Program Requires Research Proposal

This program includes a **written examination** (which may be waived), see below, a research

proposal defended orally, an **oral examination**, and a **final examination**. The research proposal sets forth and describes an original research problem and/or solution, which if carried through, would represent a significant contribution to chemical engineering knowledge. The area of the proposal may be the student's dissertation subject *only* if he has taken the written examination.

Graduate Courses

An orientation examination is used to determine whether entering students require any preliminary course work, before taking the six required core courses. After three to five quarters in residence, all Master of Engineering students and nearly all PhD students are required to take a written examination based on these core courses:

Models and Methods

Multidimensional and Discrete Systems
Thermodynamics of Reaction and Phase Equilibria
Fundamental Transport Phenomena
Process Dynamics 1 or Process Dynamics 2
Reactor Design and Optimization (Systems Program) or
Chemical Kinetics (Science Program)

During 1968 the following *additional* courses were taught by department faculty:

Mathematical Methods in Chemical Engineering

Applied Field Theory
Computer Control of Processes
Optimization Techniques
Transport Properties and Irreversible Thermodynamics
Applied Statistical Mechanics
Statistical Thermodynamics
Interfacial Transport Phenomena
Rheology
Non-Newtonian Fluid Dynamics
Chemical Energy Conversion
Particulate Systems
Applied Fluid Dynamics
Process Engineering
Process Equipment Design
Process and Plant Design
Process Economy Analysis
Tensor Fields and Fluid Dynamics
Analytical Techniques for Eng and Scientists 1
Analytical Techniques for Eng and Scientists 2
Analytical Techniques for Eng and Scientists 3

RESULTS

Student reaction to these diversified programs has been very good at both the undergraduate and graduate levels.