

# THE CHEMICAL ENGINEER IN THE CHEMICAL INDUSTRY

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**T**HE GRADUATE CHEMICAL engineer entering the chemical industry finds a system speaking a language which usually is partially unknown to him. He has probably heard many of the terms, but their meaning may be unclear or wrongly understood since he never learned the terms formally. The language will dominate his world and he will eventually learn it "by ear," but his command of it would be faster and better if he had previous exposure to the terminology. Some of the subjects met in the course described in this paper may be in their own right full courses at a department of industrial administration; this should not preclude teaching them, however briefly, both for acquaintance and awareness.

At first sight it may appear that the subjects are unrelated; however, they will be tied together as the course advances. This is due to the unity of purpose of chemical enterprises and the underlying economic goals of such organizations.



**Jacob Zabicky** graduated as chemist (1956, National University of Mexico), Ph.D. (1960, Hebrew University of Jerusalem), and chemical engineer (1983, Ben-Gurion University of the Negev). He has carried out teaching assignments on various chemistry and chemical engineering subjects in Great Britain, Venezuela and Israel. He has edited various books on organic functional groups and the organic chemical tables of the Chemical Rubber Handbook. His research interests are in industrial chemistry and the chemistry and processing of oil shales and coal. He is also involved in various industrial development projects.

## REQUIREMENTS

Fourth year chemical engineering undergraduates are preferred for their maturity. However, due to our general curricular structure, third year students are not discouraged from taking the course. Chemistry undergraduates have occasionally attended.

## TIMING

The course is given in one semester of 3 one-hour sessions per week. Originally it was a two semester course at 2 hours per week, but a curricular reform changed this.

## EXAMINATIONS AND PAPERS

One examination has to be passed at mid-term on the Law of Patents. When the course was given on a two semester schedule, an examination was also taken on the principles of quality control. The grade on the examination is 40% of the final mark. Every semester, four to six papers are written on various assignments, and their average mark is 60% of the semester grade (which is the academic unit).

## SUBJECTS OF THE COURSE

The structure of the course is shown in Table 1. Due to the need for exercises, the unit on sources of information is presented first, and the reading of the Law of Patents and its ancillary papers is assigned from the beginning. A brief description of the contents of each unit follows.

**The Productive Organization** • The functions and objectives of the various managerial levels and organic sections of productive organizations are described and rationalized. Special emphasis is given to the chemical plant, its physical, social, and legal environment. Also closely seen are related sections of the organization such as research, development, engineering, market-

ing, etc. In the two semester course the decision levels were also examined. Some subjects are discussed in the classroom as they are brought up by the lecturer or, frequently, by students with some industrial experience.

**Characteristics of the Chemical Industry** • Raw materials and their derivative chain, and industries with a chemical character, are reviewed. The chemical industry, with few exceptions, is viewed as a supplier of agricultural and industrial intermediates and not of consumer or investment products.

**Sources of Information** • The main pertinent formal sources of information are reviewed and exercised. These include technical encyclopedias, *Chemical Abstracts* (CA), *Science Citation Index* (SCI), and various collections of chemical and technological information. Acquaintance is made with *Chemical Marketing Reporter* (CMR), *Chemical Economics Handbook* (CEH), import-export statistical reports, industrial directories, "Who's Who," and company reports. The importance of reading advertisements is stressed. An on-line demonstration session of information retrieval is performed on a selected subject, showing the vari-

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ous files and the power of the method.

Exercises are as follows: the student is assigned an industrial chemical (or proposes one himself) and carries out a search starting with encyclopedias, following the subject through CA, SCI, CMR, CEH statistical reports, and answering some general leading questions. The various sections of CMR are examined. Care should be taken in choosing chemical products that are neither overloaded with information, as the student will sink for hours in a vast sea of titles, or underloaded with it which leads to frustrating hours of search. Fortunately, the list of good products is ample.

**Industrial Intelligence** • Emphasis is placed on the importance of information inflow, contacts with

**TABLE 1**  
**Course Outline**

UNIT DESCRIPTION	TIME <sup>a</sup>	READINGS <sup>b</sup>		UNIT DESCRIPTION	TIME <sup>a</sup>	READINGS <sup>b</sup>	
		Oblig.	Opt.			Oblig.	Opt.
1. The productive organization				to defend against it	2	13,14	12
a) General structure	1		1	d) Discussion	1		
b) Chemical plant and closely related sections	4		1 b	5. Research and development			
c) Discussion	1			a) Definitions and decision making	2	15	16
d) Levels of decision <sup>c</sup>	2		1 c	b) Historical background <sup>c</sup>	3	17a	
2. Characteristics of the chemical industry				6. The Law of Patents			
a) Classification of materials and products	1		2	a) Patents and patentability	3	4b,18	17b,19,20
b) Survey of chemically oriented manufacturing industries	3		3-7	b) Limitations of patents	1	4b,18	20
3. Sources of information <sup>d</sup>				c) Discussion	1		
a) Opening remarks. Explanation of the 1st assignment	1			d) Examination	2		
b) Library sources	3	4,7-9	4a,5,10,11	7. Technology transfer	3		21
c) Informal sources	1		11	8. Principles of quality control			
d) On-line retrieval demonstration	2			a) The general concepts of quality and control	1		22a
4. Industrial intelligence				b) Quality in industry and specifications	1		2b
a) Historical notes	1		12	c) Production line and analytical laboratory relations	1		22c,23
b) Industrial intelligence as source of information	1	13	12	d) Pitfalls in analysis	1		23
c) Industrial espionage and how				e) Standards and standard organizations	1	24	
				f) Contracts for chemical sales	1		
				g) Statistical principles <sup>c</sup>	8	22c	
				h) Examination <sup>c</sup>	2		

<sup>a</sup>Academic hours. Time schedules are elastic.

<sup>b</sup>Reading material is based on availability in our main Library. This may be easily adapted to local needs and tastes.

<sup>c</sup>Given only on the two semester schedule.

<sup>d</sup>This subject is the first to be presented, although it belongs logically here.

the "outer" world, the role of the sales department, some "bleak" aspects of industrial intelligence and what to do about it. The student carries out readings on the subject and responds to a questionnaire.

**Research and Development** • Formal definitions, assessment of R&D importance to industry, flow of information, and decisions on R&D are investigated. The student carries out some readings on the subject and a questionnaire is answered afterwards.

**Law of Patents** • What patents are, the requirements for patentability, limitations of the state on rights endowed by patents, patent regulations, and international agreements on patents are studied. Some discussions arise from questions by the students. The lecturer should be careful in distinguishing between awareness of the subject and technical expertise in legal matters befitting a patent attorney. The student reads the Law of Patents and other articles and is examined on the essentials of the subject.

**Technology Transfer** • The sale of know-how, and the main clauses of technological transfer agreements (subjects, ownerships, responsibilities, payments, procedures) are discussed. The same cautionary note to the lecturer on patents should apply here relative to contracts. The student reads a short patent (an agreement was also read in the two semester course) and answers a questionnaire requiring some literature search and some decisions of his own, which also cover preceding units.

**Principles of Quality Control** • Subjects reviewed are the "philosophy" of quality, the specifications of a product, what quality control is, some pitfalls in analysis, the clash of interests between buyers and sellers, contracts for the trade of chemicals, and what standards and standards organization are. In the two semester course some of the mathematics underlying sampling and acceptance-rejection decisions was learned. The student searches and reads Israeli and U.S. standards on an assigned chemical product and answers a questionnaire on the subject. In the two semester course he also solves some mathematical problems and is examined on the basics of quality control. □

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## ChE book reviews

### NUMERICAL METHODS AND MODELING FOR CHEMICAL ENGINEERS

By Mark E. Davis

John Wiley & Sons, Somerset, NJ 08873, \$24.95 (1984)

Reviewed by

Bruce A. Finlayson

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*Numerical Methods and Modeling for Chemical Engineers*, by Mark E. Davis, provides a useful step beyond the standard undergraduate curriculum. One