练 习 十 六

1. The chemical and biochemical industries face intense pressures to improve efficiency, product quality, and human safety, whilst reducing the environmental impact of their operations. Increasingly, the synthesis and analysis of a product and/or its manufacturing process as a complete system is the key to success.

2. Extensive research efforts are currently underway in the areas of batch process development and design, process modeling, simulation and optimization, process operations and control, product and molecular design, and process safety. Environmental considerations are increasingly important in all these activities, in particular the use of process systems engineering to redesign entire processes to prevent pollution. Research is supported by state-of-the-art computer facilities and software utilities, and close collaborations with major chemical industry companies. New problem formulations and solution approaches are based on the integration of classical frameworks of analysis (e.g., control theory, optimization theory, calculus of variations, statistics, numerical analysis) with recent advances in computer science and technology (e.g., artificial intelligence, symbolic manipulation, the object-oriented paradigm).

3. All processes are subject to disturbances that tend to change operating conditions, compositions, and physical properties of the streams. In order to minimize the ill effects that could result from such substantial amounts of instrumentation and automatic control equipment. In critical cases and in especially large plants, moreover, the instrumentation is computer monitored for convenience, safety, and optimization.

4. In order for a process to be controllable by machine, it must represented by a mathematical model. Ideally, each element of a dynamic process, for example, a reflux drum or an individual tray of a fractionator, is represented by differential equation based on material and energy balances. Transfer rates, stage efficiencies, phase equilibrium relations, etc., as well as the parameters of sensing devices, control valves, and control instruments. The process as a whole then is equivalent to a system of ordinary and partial differential equations involving certain independent ad dependent variables. When the values of the independent variables are specified or measured, corresponding values of the others are found by computation, and the information is transmitted to the control instruments. For example, if the temperature composition, and flow rate of the feed to a fractionator are perturbed, the computer will determine the other flows and the heat balance required to maintain constant overhead purity. Economic factors also can be incorporated in process models; then the computer can be made to optimize the operation continually.

5. **Communications** The ability to express oneself well is a very important requirement of the successful engineer, for the proof of accomplishment must be communicated in some form so that the accomplishment may be ultimately usable in the industrial environment. The most brilliant piece of research, the most inventive production plan, the shrewdest evaluation of competitors' pricing policy, all are wasted unless effectively communicated so that the information can be used. Regrettably, many engineers are poor communicators, and their representations, both oral and written, tend to be insufferably boring and, as a result, frequently misrepresented. Those engineers who enter the industrial environment and who lack the required background of communication skills had better start working hard to develop those skills, for they are needed badly in the course of personally satisfying professional development and career advancement. The problem of underdeveloped skills in any technical area; the solution is to face the problem head on, to take advantage of learning opportunities, and to practice. It is really not particularly surprising to find many neophyte engineers lacking communication skills, for so many university chemical engineering curricula concentrate on the technical requirement s of the profession; some attempt is usually made to give practice in technical writing, but the humanities, so important to the development of a personal communication style, are often neglected

6. **Continuing Education** The profession of chemical engineering is an unusually dynamic one. Development in theory, in new techniques and applications, in advanced equipment, and in related fields are rapid, and engineers who are satisfied to sit tight on their academic background alone find themselves rapidly obsolete. Regrettably, the profession is full of individuals who have not heeded this warning and whose technical effectiveness has suffered correspondingly. The dedicated chemical engineer must be ready to continue to develop technically, to keep up-to-date by taking advantage of opportunities in continuing education.