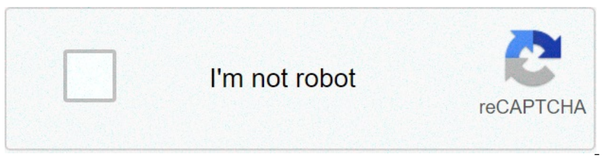

Continue

Elements of chemical reaction engineering 4th edition free pdf

Catalysis "J Q and Catalytic Reactors It isn't that they can't see the solution. It is that they can't see the problem. About the Author: H. Scott Fogler is the Arthur F. Thurnau Professor, Vennema Professor of Chemical Engineering at the University of Michigan. His research interests include flow and reaction in porous media, fused chemical relations, gellation kinetics, and chemical reaction engineering problems in the petroleum industry. He has graduated 37 Ph.D. students and has more than 200 refereed publications in these areas. Fogler is the AIChE 2008 President-elect. He has chaired ASEE's Chemical Engineering Division, served as director of the American Institute of Chemical Engineers, earned the Warren K. Lewis Award from AIChE for contributions to chemical engineering education, and received the Chemical Manufacturers Association's National Catalyst Award. He is the co-author of the bestselling textbook Strategies for Creative Problem Solving, Second Edition (Prentice Hall, 2008). Excerpt. © Reprinted by permission. All rights reserved.: The man who has ceased to learn ought not to be allowed to wander around loose in these dangerous days. —M. M. Coady A. The Audience This book and interactive CD-ROM is intended for use as both an undergraduate-level and a graduate-level text in chemical reaction engineering. The level will depend on the choice of chapters and CD-ROM Professional Reference Shelf (PRS) material to be covered and the type and degree of difficulty of problems assigned. B. The Goals B.1.To Develop a Fundamental Understanding of Reaction Engineering The first goal of this book is to enable the reader to develop a clear understanding of the fundamentals of chemical reaction engineering (CRE). This goal will be achieved by presenting a structure that allows the reader to solve reaction engineering problems through reasoning rather than through memorization and recall of numerous equations and the restrictions and conditions under which each equation applies. The algorithms presented in the text for reactor design provide this framework, and the homework problems will give practice at using the algorithms. The conventional home problems at the end of each chapter are designed to reinforce the principles in the chapter. These problems are about equally divided between those that can be solved with a calculator and those that require a personal computer and a numerical software package such as Polymath, MATLAB, or FEMLAB. To give a reference point as to the level of understanding of CRE required in the profession, a number of reaction engineering problems from the California Board of Registration for Civil and Professional Engineers—Chemical Engineering Examinations (PECEE) are included in the text.1 Typically, these problems should each require approximately 30 minutes to solve. Finally, the CD-ROM should greatly facilitate learning the fundamentals of CRE because it includes summary notes of the chapters, added examples, expanded derivations, and self tests. A complete description of these learning resources is given in the "The Integration of the Text and the CD-ROM" section in this Preface. B.2. To Develop Critical Thinking Skills A second goal is to enhance critical thinking skills. A number of home problems have been included that are designed for this purpose. Socratic questioning is at the heart of critical thinking, and a number of homework problems draw from R. W. Paul's six types of Socratic questions2 shown in Table P-1. TABLE P-1. SIX TYPES OF SOCRATIC QUESTIONS Questions for clarification: Why do you say that? How does this relate to our discussion? "Are you going to include diffusion in your mole balance equations?" Questions that probe assumptions: What could we assume instead? How can you verify or disprove that assumption?"Why are you neglecting radial diffusion and including only axial diffusion?" Questions that probe reasons and evidence: What would be an example? "Do you think that diffusion is responsible for the lower conversion?" Questions about viewpoints and perspectives: What would be an alternative? "With all the bends in the pipe, from an industrial/practical standpoint, do you think diffusion and dispersion will be large enough to affect the conversion?" Questions that probe implications and consequences: What generalizations can you make? What are the consequences of that assumption? "How would our results be affected if we neglected diffusion?" Questions about the question: What was the point of this question? Why do you think I asked this question? "Why do you think diffusion is important?" Scheffer and Rubenfeld3,4 expand on the practice of critical thinking skills discussed by R. W. Paul by using the activities, statements, and questions shown in Table P-2. TABLE P-2. CRITICAL THINKING SKILLS2,3 Analyzing: separating or breaking a whole into parts to discover their nature, function, and relationships "I studied it piece by piece." "I sorted things out." Applying Standards: judging according to established personal, professional, or social rules or criteria "I judged it according to...." Discriminating: recognizing differences and similarities among things or situations and distinguishing carefully as to category or rank "I rank ordered the various...." "I grouped things together." Information Seeking: searching for evidence, facts, or knowledge by identifying relevant sources and gathering objective, subjective, historical, and current data from those sources "I knew I needed to look up/study...." "I kept searching for data." Logical Reasoning: drawing inferences or conclusions that are supported in or justified by evidence "I deduced from the information that...." "My rationale for the conclusion was...." Predicting: envisioning a plan and its consequences "I envisioned the outcome would be...." "I was prepared for...." Transforming Knowledge: changing or converting the condition, nature, form, or function of concepts among contexts "I improved on the basics by...." "I wondered if that would fit the situation of ...." I have found the best way to develop and practice critical thinking skills is to use Tables P-1 and P-2 to help students write a question on any assigned homework problem and then to explain why the question involves critical thinking. More information on critical thinking can be found on the CD-ROM in the section on Problem Solving. B.3. To Develop Creative Thinking Skills The third goal of this book is to help develop creative thinking skills. This goal will be achieved by using a number of problems that are open-ended to various degrees. Here the students can practice their creative skills by exploring the example problems as outlined at the beginning of the home problems of each chapter and by making up and solving an original problem. Problem P4-1 gives some guidelines for developing original problems. A number of techniques that can aid the students in practicing and enhancing their creativity can be found in Fogler and LeBlanc5 and in the Thoughts on Problem Solving section on the CD-ROM and on the web site www.engin.umich.edu/~cre. We will use these techniques, such as Osborn's checklist and de Bono's lateral thinking (which involves considering other people's views and responding to random stimulation) to answer add-on questions such as those in Table P-3. TABLE P-3. PRACTICING CREATIVE THINKING Brainstorm ideas to ask another question or suggest another calculation that can be made for this homework problem. Brainstorm ways you could work this homework problem incorrectly. Brainstorm ways to make this problem easier or more difficult or more exciting. Brainstorm a list of things you learned from working this homework problem and what you think the point of the problem is. Brainstorm the reasons why your calculations overpredicted the conversion that was measured when the reactor was put on stream. Assume you made no numerical errors on your calculations. "What if..." questions: The "What if..." questions are particularly effective when used with the Living Example Problems where one varies the parameters to explore the problem and to carry out a sensitivity analysis. For example, what if someone suggested that you should double the catalyst particle diameter, what would you say? One of the major goals at the undergraduate level is to bring students to the point where they can solve complex reaction problems, such as multiple reactions with heat effects, and then ask "What if..." questions and look for optimum operating conditions. One problem whose solution exemplifies this goal is the Manufacture of Styrene, Problem P8-26. This problem is particularly interesting because two reactions are endothermic and one is exothermic. Ethylbenzene→Styrene + Hydrogen: Endothermic Ethylbenzene→Benzene + Ethylene: Endothermic Ethylbenzene + Hydrogen→Toluene + Methane: Exothermic To summarize Section B, it is the author's experience that both critical and creative thinking skills can be enhanced by using Tables P-1, P-2, and P-3 to extend any of the homework problems at the end of every chapter. C. The Structure The strategy behind the presentation of material is to build continually on a few basic ideas in chemical reaction engineering to solve a wide variety of problems. These ideas, referred to as the Pillars of Chemical Reaction Engineering, are the foundation on which different applications rest. From these Pillars we construct our CRE algorithm: Mole balance + Rate laws + Stoichiometry + Energy balance + Combine With a few restrictions, the contents of this book can be studied in virtually any order after students have mastered the first four chapters. Table P-4 shows examples of topics that can be covered in a graduate course and an undergraduate course. In a four-hour undergraduate course at the University of Michigan, approximately eight chapters are covered in the following order: Chapters 1, 2, 3, 4, and 6; Sections 5.1-5.3; and Chapters 7, 8, and parts of Chapter 10. TABLE P-4. UNDERGRADUATE/GRADUATE COVERAGE OF CRE Undergraduate Material/Course Mole Balances (Ch. 1) Smog in Los Angeles Basin (PRS Ch. 1) Reactor Staging (Ch. 2) Hippopotamus Stomach (PRS Ch. 2) Rate Laws (Ch. 3) Stoichiometry (Ch.3) Reactors (Ch. 4):Batch, PFR, CSTR, PBR, Semibatch, Membrane Data Analysis: Regression (Ch. 5) Multiple Reactions (Ch. 6) Blood Coagulation (SN Ch. 6) Bioreaction Engineering (Ch. 7) Steady-State Heat Effects (Ch. 8):PFR and CSTR with and without a Heat ExchangerMultiple Steady States Unsteady-State Heat Effects (Ch. 9)Reactor Safety Catalysis (Ch. 10) Graduate Material/Course Short Review (Ch. 1-4, 6, 8) Collision Theory (PRS Ch. 3) Transition State Theory (PRS Ch. 3) Molecular Dynamics (PRS Ch. 3) Aerosol Reactors (PRS Ch. 4) Multiple Reactions (Ch. 6):Fed Membrane Reactors Bioreactions and reactors (Ch. 7, PRS 7.3, 7.4, 7.5) Polymerization (PRS Ch. 7) Co- and Counter Current Heat Exchange (Ch. 8) Radial and Axial Gradients in a PFRFEMLAB (Ch. 8) Reactor Stability and Safety (Ch. 8, 9, PRS 9.3) Runaway Reactions (PRS Ch. 8) Catalyst Deactivation (Ch. 10) Residence Time Distribution (Ch. 13) Models of Real Reactors (Ch. 14) Applications (PRS): Multiphase Reactors, CVD Reactors, Bioreactors The reader will observe that although metric units are used primarily in this text (e.g., kmol/m3, J/mol), a variety of other units are also employed (e.g., lb/ft3). This is intentional! We believe that whereas most papers published today use the metric system, a significant amount of reaction engineering data exists in the older literature in English units. Because engineers will be faced with extracting information and reaction rate data from older literature as well as the current literature, they should be equally at ease with both English and metric units. The notes in the margins are meant to serve two purposes. First, they act as guides or as commentary as one reads through the material. Second, they identify key equations and relationships that are used to solve chemical reaction engineering problems. D. The Components of the CD-ROM The interactive CD-ROM is a novel and unique part of this book. The main purposes of the CD-ROM are to serve as an enrichment resource and as a professional reference shelf. The home page for the CD-ROM and the CRE web site can be found at www.engin.umich.edu/~cre/fogler&gurmen. The objectives of the CD-ROM are threefold: (1) to facilitate the learning of CRE by interactively addressing the Felder/Solomon Inventory of Learning Styles 6 in the Summary Notes, the additional examples, the Interactive Computing Modules (ICMs), and the Web Modules; (2) to provide additional technical material for the professional reference shelf; (3) to provide other tutorial information, examples, derivations, and self tests, such as additional thoughts on problem solving, the use of computational software in chemical reaction engineering, and representative course structures. The following components are listed at the end of most chapters and can be accessed from each chapter in the CD-ROM. · Learning Resources The Learning Resources give an overview of the material in each chapter and provide extra explanations, examples, and applications to reinforce the basic concepts of chemical reaction engineering. The learning resources on the CD-ROM include the following: Summary Notes—The Summary Notes give an overview of each chapter and provide on-demand additional examples, derivations, and audio comments as well as self tests to assess each reader's understanding of the material. Web Modules—The Web Modules, which apply key concepts to both standard and nonstandard reaction engineering problems (e.g., the use of wetlands to degrade toxic chemicals, cobra bites), can be loaded directly from the CD-ROM. Additional Web Modules are expected to be added to the web site (www.engin.umich.edu/~cre) over the next several years. Interactive Computer Modules (ICMs)—Students have found the Interactive Computer Modules to be both fun and extremely useful to review the important chapter concepts and then apply them to real problems in a unique and entertaining fashion. In addition to updating all the ICMs from the last edition, two new modules, The Great Race (Ch. 6) and Enzyme Man (Ch. 7), have been added. The complete set of 11 modules follows:· Quiz Show I (Ch. 1)· Reactor Staging (Ch. 2) · Quiz Show II (Ch. 3) · Murder Mystery (Ch. 4) · Tic Tac (Ch. 4)· Ecology (Ch. 5) · The Great Race (Ch. 6)· Enzyme Man (Ch. 7)· Heat Effects I (Ch. 8)· Heat Effects II (Ch. 8)· Catalysis (Ch. 10) Solved Problems—A number of solved problems are presented along with problem-solving heuristics. Problem-solving strategies and additional worked example problems are available in the Problem Solving section of the CD-ROM. · Living Example Problems A copy of Polymath is provided on the CD-ROM for the students to use to solve the homework problems. The example problems that use an ODE solver (e.g., Polymath) are referred to as "living example problems" because students can load the Polymath program directly onto their own computers in order to study the problem. Students are encouraged to change parameter values and to "play with" the key variables and assumptions. Using the Living Example Problems to explore the problem and asking "What if..." questions provide students with the opportunity to practice critical... "About this title" may belong to another edition of this title. elements of chemical reaction engineering 4th edition free pdf. elements of chemical reaction engineering 4th edition pdf free download