

TEMPLATE FOR COURSE SPECIFICATION (Catalysis and Catalytic Engineering)

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

COURSE SPECIFICATION

This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	University of Technology
2. University Department/Centre	Chemical Engineering Department
3. Course title/code	CE.446
4. Programme(s) to which it contributes	B.Sc. Chem. Eng.
5. Modes of Attendance offered	Fall
6. Semester/Year	one semester/year
7. Number of hours tuition (total)	3
8. Date of production/revision of this Specification	6-6-2016
9. Aims of the Course	
1. To introduce and define a special knowledge in the catalyst and catalysis science for the 4 th year B.Sc. students in the Chemical Engineering Department.	
2. Provide the basic principles of catalyst and catalysis science using the laws and mathematical equations and then applied them to study the behavior of catalysts during chemical reactions..	
3. Helping to understand the fundamental principles of catalyst and catalysis science and its applications in the kinetics of chemical reactions in terms of the transmission of mass, heat and momentum within the catalyst in the reactors.	
4. Providing the necessary means and the available facilities in order to understand the mechanism of the effect of catalysts on the progress of chemical reactions.	

10• Learning Outcomes, Teaching ,Learning and Assessment Method

A- Knowledge and Understanding

- A1. Using the fundamental laws and mathematical models in understanding the basic mechanism of chemical interactions occurring within the catalysts.
- A2. Explain the effectiveness of the presence of catalysts on the kinetic and thermodynamic properties within a chemical system.
- A3. Classification the properties of heterogeneous catalysts (activity, acidity, selectivity, and porosity) and their relationship with the behaviour of catalyst during the progress of chemical reactions .
- A4. Describe the diffusivity of the movement of reactant molecules around and throughout the body of a catalyst in different types of chemical reactors (fixed-, fluidized-, slurry-, and trickle-bed) and their applications in the design of the reactors.
- A5. Knowledge about the modern characterization techniques utilized to determine the properties and specifications of the framework of synthesized catalysts.

B. Subject-specific skills

- B1. Identify and analyze ways to build the framework structure and characteristics of the catalyst during its manufacture and its relationship with the main goal of which it is used in the chemical reaction involved.
- B2. Determine and evaluate the relationship of the applied catalyst in improving the final product of the chemical reaction .
- B3. Elucidate concepts to reduce the activation energy of a chemical reaction by changing the mechanism and increase the reaction rate by supplying acidic sites inside the catalyst particles.
- B4. Account the actual values of diffusivity of the reactant materials in the channels of the catalyst and the associated design equations and their relationship to reaction output (yield).

Teaching and Learning Methods

The development of the student's ability to apply the knowledge and the order to be able to correct analysis of the problems and issues, which are related to the catalyst and catalysis science and thus put the appropriate assumptions and interpretation to reach a solution through lecturing and participation by the training and conduct various tests in this topic.

Assessment methods

- The classroom discussions and identify the possibilities of a student on the analysis of the issues and his response.
- Homework.
- Sudden exams (Quizzes).
- Midterm and final exams.
- Open questions and reports.

C. Thinking Skills

- C1. Recognize the importance of catalyst and catalysis science in the process industry, problem solving, and other related issues. In addition to evaluate scientific and engineering information and identify knowledge about the performance of a catalyst in enhancing the reaction products.
- C2. Description the equipments and techniques used in manufacturing the catalyst and also examine its operating properties.
- C3. Understanding of the theories and laws (design equations) of catalytic reactions in various chemical reactors (fixed-, fluidized-, slurry-, and trickle-bed) that use layers of catalyst as a key parameter in their work.
- C4. Comprehension the principle of both Knudsen diffusion and bulk diffusion on the internal and external surfaces of the catalyst particles, and their impact on the nature of the reaction products in terms of increasing the quantity and quality with reducing the operating cost.

Teaching and Learning Methods

Encourage students to develop their capabilities in data analysis question and establish the problem and describe the solution through lecturing, practical applications, and participation by the training and conduct various tests in this topic.

Assessment methods

- The classroom discussions and identify the possibilities of a student on the analysis of the issues and his response.
- Homework.
- Quizzes.
- Midterm and final exams.
- Scientific reports.
- Open questions that have a definite answer , or do not have a definite answer.

D. General and Transferable Skills (other skills relevant to employability and personal development).

Develop the student's ability to be familiar with the modern tools, information technology and their relationship to the engineering applications, and to identify the theoretical knowledge about the equipments and characterization techniques used in catalyst science due to the lack of a special laboratory at the moment.

11. Course Structure					
Week	Hours	ILOs	Unit/Module or Topic Title	Teaching Method	Assesment Method
semester					
1	3 per week = (2 Theoretical + 1 Tutorial)	Definition of catalysts	Introduction of catalyst.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions
2	3 per week = (2 Theoretical + 1 Tutorial)	Properties (activity, acidity, selectivity, and porosity) of catalysts.	Characteristics of catalysts.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution..	Classroom Discussions Homework
3	3 per week = (2 Theoretical + 1 Tutorial)	Description the relationships between catalysts and activation energy.	Rate equations of fluid solid catalytic reactions.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Quizzes
4	3 per week = (2 Theoretical + 1 Tutorial)	Description the relationships between catalysts and both rate / time of reaction, and pressure in the catalytic reactors.	Rate equations of fluid solid catalytic reactions.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions
5	3 per week = (2 Theoretical + 1 Tutorial)	Description theories and major design equations, which are found to be associated with the catalytic reactions.	Reactions on solid catalyst.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Homework
6	3 per week = (2 Theoretical + 1 Tutorial)	External diffusion of reactant molecules on the catalyst surface in the four basic types of chemical reactors.	External diffusion and reactions in (fixed-, fluidized-, slurry-, and trickle-bed).	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions

7	3 per week = (2 Theoretical + 1 Tutorial)	External diffusion of reactant molecules on the catalyst surface in the four basic types of chemical reactors.	External diffusion and reactions in (fixed-, fluidized-, slurry-, and trickle-bed).	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Quizzes
8	3 per week = (2 Theoretical + 1 Tutorial)	External diffusion of reactant molecules on the catalyst surface in the four basic types of chemical reactors.	External diffusion and reactions in (fixed-, fluidized-, slurry-, and trickle-bed).	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Midterm exams
9	3 per week = (2 Theoretical + 1 Tutorial)	Practical examples and applications to analyze the reaction rate within the catalytic reactions.	Practical example for catalytic reactions.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions
10	3 per week = (2 Theoretical + 1 Tutorial)	Internal diffusion of reactant molecules inside the framework structure of catalyst and its applications.	Internal diffusion and practical example in the heterogeneous reactions.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution	Classroom Discussions Homework
11	3 per week = (2 Theoretical + 1 Tutorial)	Internal diffusion of reactant molecules inside the framework structure of catalyst and its applications.	Internal diffusion and practical example in the heterogeneous reactions.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions
12	3 per week = (2 Theoretical + 1 Tutorial)	Mathematical models for the design of catalyst in the catalytic reactors (parallel-pore model).	Mathematical models for the catalyst.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Quizzes
13	3 per week = (2 Theoretical + 1 Tutorial)	Mathematical models for the design of catalyst in the catalytic reactors (random-pore model).	Mathematical models for the catalyst.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Homework

14	3 per week = (2 Theoretical + 1 Tutorial)	The development of the catalyst industry.	Developing industrial catalysts & characterization techniques.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Scientific reports
15	3 per week = (2 Theoretical + 1 Tutorial)	The development of the modern instruments and equipment used to determine the characteristics and specifications of the catalyst.	Developing industrial catalysts & characterization techniques.	Encourage students through lectures on the development of their capabilities in data analysis in order to establish the problem and describe the solution.	Classroom Discussions Final exams

12. Infrastructure

Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	-Lecturers - J. M. Smith (1981), Chemical Engineering Kinetics, 3 rd edition, Mc Grow – Hill, Singapore. - A. Dyer (1988), An introduction to zeolite molecular sieves, by John Wiley & sons Ltd. - Daniel Decroocq (1984), catalytic cracking of heavy petroleum fractions, by imprimerie- Jean, France. - J.F. Lepage, J. Cosyns & P.Couty Applied heterogeneous catalysis.
Special requirements (include for example workshops, periodicals, IT software, websites)	http://www.uotechnology.edu.iq/dep-chem-eng/LECTURE/4Y/O/Catalyst%20and%20catalysis.pdf
Community-based facilities (include for example, guest Lectures , internship , field	Field trip (Visits to work sites)

13. Admissions

Pre-requisites	Program of study (syllabus) focuses on in-depth understanding of the catalyst and its impact on chemical reactions as well as the use and application of the design equations for reactors containing the catalyst particles, and that is why the student should be taught few subjects like mass transfer, heat transfer, reactor design and physical chemistry. And also he must has the ability to communicate in English (reading and writing).
Minimum number of students	Central Admission
Maximum number of students	Central Admission