

Table 2.1 Knowledge, skills and competences

Superordinate Educational Objectives	Learning Outcomes -Knowledge -Skills -Competence
(a) Knowledge and understanding	<p>Knowledge:</p> <ul style="list-style-type: none"> <li>a1. The graduates have acquired sufficient knowledge of chemistry, physics, mathematics and computer science to understand deeply and treat (e.g. computationally) the phenomena occurring in the field of chemical engineering.</li> <li>a2. They understand deeply the phenomena in chemical engineering, such as chemical reactions and chemical kinetics, energy, mass and momentum transport, thermodynamic equilibrium, phase changes, mixing and fluid dynamics and the scientific theories explaining them.</li> <li>a3. The graduates know about the latest developments and new trends in chemical engineering science.</li> <li>a4. The graduates are familiar with the conventional and modern methods of chemical analysis and measurement techniques of process industry.</li> <li>a5. The graduates are familiar with the basics and application principles of process control and automation.</li> <li>a6. The graduates know basics of other engineering disciplines to the extent which enables them to communicate and work with specialists of other fields.</li> <li>a7. The graduates are familiar with basics of industrial economics, e.g. estimation of investment and operation costs and profitability. They also know basics of market analysis.</li> </ul>
(b) Knowledge management	<p>Skills:</p> <ul style="list-style-type: none"> <li>b1. The graduates can acquire data and information of their field from scientific literature, patent literature, internet and different databanks.</li> </ul> <p>Competences:</p> <ul style="list-style-type: none"> <li>b2. The graduates can estimate and check the reliability of information obtained from different sources. They have sound critical attitude towards the knowledge from all sources and they are able to recognize the most relevant aspects from a large amount information.</li> <li>b3. The graduates can present and document new and refined information in a right way. They can take into account the purpose of the information in the reporting (e.g. scientific paper, technical report, teaching material, patent application...).</li> </ul>

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Superordinate Educational Objectives	Learning Outcomes -Knowledge -Skills -Competence
(c) Engineering analysis and investigations	<p>Knowledge:</p> <p>c5. The graduates are familiar with the principles and features of experimentation at different scales, ie. in laboratory, bench-scale, pilot plant and full scale.</p> <p>Skills:</p> <p>c6. The graduates can carry out mathematical and technical experiment planning and statistical analysis of experimental results. They recognize the difference between empirical and model-based experiment planning.</p> <p>c7. The graduates can develop mechanistic and empiric models for phenomena, processes and equipment in chemical engineering.</p> <p>c9. The graduates can solve real problems with software common in chemical engineering and chemistry (e.g. Matlab, Aspen, Balas).</p> <p>c10. The graduates are familiar with the methodology of parallel experimental and computational work. They are able to carry out parameter estimation, model validation and identification of real parameter values on the basis of statistical analysis.</p> <p>Competences:</p> <p>c1. The graduates can formulate and define the problems to be solved in such a way that the solution is as useful as possible in the current situation and that the solution is possible taking into account the initial data, methods and resources available.</p> <p>c2. The graduates are able to consider, analyse and evaluate products, processes and methods of their field on a systems engineering base.</p> <p>c3. The graduates can apply their general and chemical engineering knowledge holistically to solve problems. They are able to use phenomena-based, mechanistic methodology in their work.</p> <p>c4. The graduates can select appropriate methods to solve the problems at hand. These methods are typically experimental or computational (modeling, simulation, experiment planning...), often combinations of them. In a wide sense, this means preparing an extensive research plan.</p> <p>c8. They are able to use process models in problem solving through simulation, optimization and experiment planning.</p> <p>c11. They can explain under which conditions the solution has been obtained, what is its range of validity and how reliable it is. They also understand that it is important to document this additional information together with the solution.</p> <p>c12. The graduates can also work with ill-defined problems, problems with insufficient initial data and problems in new, emerging fields of technology.</p>

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(d) Engineering design and development	<p>Knowledge:</p> <p>d1. The graduates know the typical stages and principles of process development and design. They are also familiar with modern design procedures and methods.</p> <p>d2. The graduates know the usual unit operations and equipment of process industry, as well as their most common selection criteria and design methods. Especially they are familiar with separation technology. They are also able to consider novel alternatives instead of traditional choices in process synthesis.</p> <p>d4. The graduates are familiar with principles and methods of process optimization, as well as goals and methods of process intensification and process integration.</p> <p>d6. The graduates are familiar with the typical documents of process design (process diagrams, drawings, specifications, instructions...). They can both prepare and interpret such documents.</p> <p>d7. The graduates are familiar and have trained project work and project management.</p> <p>Skills:</p> <p>d3. The graduates can calculate material and energy balances for processes and apply simulation programs in this task. They are also familiar with the possibilities to use balances in data reconciliation.</p> <p>d5. The graduates can define control, measurement and analysis requirements of the process to be designed. They are able to suggest and compare different control strategies.</p> <p>d8. The graduates can estimate costs and profitability of products and processes to be designed. They can also perform economical sensitivity and risks analysis and carry out preliminary financial planning.</p>
(e) Engineering practice	<p>Skills:</p> <p>e3. The graduates are familiar with the principles of project work and project management. They understand the importance of well planned, goal-driven work where technical and economical goals, as well as timetables are defined and their realization is followed. They have trained these activities.</p> <p>Competences:</p> <p>e1. The graduates can apply their theoretical knowledge to practical problems. They understand that what is needed in practice is usually a combination of theoretical, experimental and subjective, experience-based knowledge.</p> <p>e2. They are able to make expert assumptions, estimates and</p>

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	approximations when more accurate information is not available. At the same time they recognize their responsibility about the reliability of results.
	<p>e4. The graduates are able to take safety and environmental aspects into account in all activities, e.g. in research, design and production. They are familiar with the methods and the most important legislation concerning SHE (safety, health, environment).</p> <p>e5. The graduates have been trained to apply their creativity. They have skills and courage to look for novel solutions and develop new technology in research, design and production.</p>
(f) Transferable skills	<p>Knowledge:</p> <p>f6. The graduates are aware of the responsibility of their work, its ethical requirements and its influence on society.</p> <p>Skills:</p> <p>f1. The graduates are capable to co-operation and teamwork.</p> <p>f2. The graduates are capable to written and oral communication.</p> <p>f4. The graduates have initiative and they can work independently.</p> <p>Competences:</p> <p>f3. They are able to work in interdisciplinary and multicultural teams and projects.</p> <p>f5. The graduates are competent to adopt new knowledge and they understand that learning is a process which continues through their professional life.</p>



Table 2.2b Knowledge management

(b) Knowledge management			
Module	b1	b2	b3
BJ70A0801	moderate	moderate	moderate
BJ60A1200	moderate		
BJ60A1300	moderate		
BJ50A0001		moderate	
BJ50A0400	moderate	moderate	moderate
BJ90A0200	moderate	moderate	moderate
BJ90A0720	moderate	moderate	moderate
BJ20A1901	moderate	moderate	moderate
BJ40A0000	moderate		
BJ90A0710	moderate		
BJ30A0500	moderate	moderate	moderate
BJ40A0100		moderate	
BJ30A1401	moderate	moderate	moderate
BJ60A0501			moderate
BJ10A0201	moderate	high	high
BJ60A1000	moderate	moderate	moderate
BJ60A1100	moderate	moderate	moderate
BJ60A1400	moderate		

Table 2.2c Engineering analysis and investigations

(c) Engineering analysis and investigations												
Module	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12
BM20A1900							moderate		moderate			
BM20A2701							moderate		moderate			
BM20A3900							high	high	moderate	moderate		
BJ30A0600			high			moderate	high	high	moderate	high	moderate	
BJ70A0801					moderate	moderate	moderate			moderate	moderate	
BJ80A0900											moderate	
BJ20A1100					moderate							
BJ20A1801			high	moderate			moderate	moderate				
BJ50A0001					moderate							
BJ50A0400	moderate		moderate		moderate						moderate	
BJ90A0200	moderate		moderate	moderate	moderate	moderate	moderate				moderate	moderate
BJ90A0720					moderate						moderate	

Table 2.2c Engineering analysis and investigations

(c) Engineering analysis and investigations												
Module	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12
BJ20A1901	high		moderate	high							moderate	moderate
BJ40A0000	moderate											
BJ10A0400		moderate										
BJ30A0500		high										
BJ40A0100		moderate		moderate								moderate
BJ30A1401	moderate											moderate
BJ60A0501	moderate				moderate	moderate					moderate	
BJ10A0201	high			high							moderate	moderate
BJ60A1000	moderate			moderate								
BJ60A1100	moderate			moderate							moderate	moderate
BJ30A1100		high					moderate	moderate				
BJ30A0700			moderate				moderate	moderate	high			
BJ70A1100				moderate								
BJ30A1600							moderate	high	high			
BJ80A0500											moderate	

Table 2.2d Engineering design and development

(d) Engineering design and development								
Module	d1	d2	d3	d4	d5	d6	d7	d8
BJ70A0801					moderate			
BJ60A1200		moderate			moderate			
BJ50A0001		moderate						
BJ50A0400			moderate					
BJ30A0500	high	moderate	moderate		moderate	high	high	moderate
BJ40A0100	moderate						moderate	
BJ30A1401							moderate	moderate
BJ60A1100		moderate						
BJ60A1400		moderate			moderate			
BJ20A1801		high	moderate		moderate			
BJ20A1100		moderate						
BJ60A1500		moderate						
BJ30A1600			high					
BJ30A1100			moderate	moderate				
BJ30A0600				moderate				
BJ10A0400					moderate			

Table 2.2e Engineering practice

(e) Engineering practice					
Module	e1	e2	e3	e4	e5
BJ70A0801				moderate	
BJ50A0001	moderate				
BJ50A0400					moderate
BJ90A0200	moderate		moderate		
BJ90A0720	moderate				
BJ20A1901		moderate		high	moderate
BJ40A0000					high
BJ30A0500	high	high	high	moderate	moderate
BJ40A0100	high				moderate
BJ30A1401	high	high	moderate		moderate
BJ60A0501	moderate	moderate		moderate	
BJ10A0201	high				
BJ30A0900				high	
BJ30A1100				moderate	
BJ40A0300				moderate	

Table 2.2f Transferable skills

(f) Transferable skills					
Module	f1	f2	f3	f4	f6
BJ70A0801	moderate	moderate	moderate		moderate
BJ80A0900				moderate	
BJ60A1200	moderate				
BJ60A1300	moderate	moderate			
BJ50A0001	moderate	moderate			
BJ50A0400		moderate		moderate	
BJ90A0200	moderate	moderate		moderate	
BJ90A0720		moderate		moderate	
BJ20A1901				moderate	
BJ40A0000	moderate	moderate	moderate		
BJ90A0710		moderate			
BJ30A0500	moderate	moderate	high		
BJ40A0100	moderate	moderate		moderate	
BJ30A1401	moderate	moderate		moderate	moderate
BJ60A0501	moderate	moderate			
BJ10A0201		moderate		high	moderate
BJ60A1000		moderate		moderate	
BJ60A1100		moderate		moderate	
BJ60A1400	moderate	moderate			
BJ10A0500	moderate		high		
BJ20A1100	moderate	moderate			
BJ20A1801	moderate	moderate	moderate		
BJ30A0900	moderate				
BJ30A1100		moderate			
BJ80A0500		moderate		moderate	
BJ40A0300			moderate		moderate

Note: Outcome f5 is supported by all of the modules.