Appendix H: Sample Survey

The specific objectives of the CDIO Syllabus are to create a clear, complete, and consistent set of goals for undergraduate engineering education, in sufficient detail that they could be understood and implemented by engineering faculty. These goals can form the basis for rational design of curricula (i.e. they are a requirements document), and as the basis for a comprehensive system of assessment. Our goal was to create a list which is rationalized against the norms of contemporary engineering practice, comprehensive of all known other sources, and peer-reviewed by experts in the field. Further, we sought to develop a listing that was prioritized, appropriate to university education, and expressed as learning objectives.

To accomplish the prioritization we used a two-step process. In the first step we provided the list of topics from the syllabus to our review group. They were asked to identify the proficiency or competence level expected of a graduating senior for each topic. As noted in the text, the consistency of desired proficiency among the diverse members of our survey participants was remarkable.

To further refine the desired level of proficiency for each sub-topic we asked the survey participants to go through the syllabus a second time. In this pass they adjusted the desired level of proficiency for the sub-topics relative to the selected proficiency at the topic level. They were allowed to identify at most one (or two, when there a large number of subtopics) subtopic that required a higher level of proficiency than the overall topic. If they chose to elevate the proficiency of sub-topics they were required to identify a matching number of sub-topics to reduce the desired level of proficiency so that the average level matched the overall level for that topic.

The following survey is a template that implements this two step process.

Circle one level of proficiency for each topic				
1. To have experienced or been exposed to	2. To be able to participate in and contribute to	3. To be able to understand and explain	4. To be skilled in the practice or implementation	5. To be able to lead or innovate in

2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES

2.1 ENGINEERING REASONING AND PROBLEM SOLVING [e] *Problem Identification and Formulation* *Modeling* *Estimation and Qualitative Analysis* *Analysis With Uncertainty* *Solution and Recommendation*	1	2	3	4	5
2.2 EXPERIMENTATION AND KNOWLEDGE DISCOVERY [b] *Hypothesis Formulation* *Survey of Print and Electronic Literature* *Experimental Inquiry* *Hypothesis Test, and Defense*	1	2	3	4	5
2.3 SYSTEM THINKING *Thinking Holistically* *Emergence and Interactions in Systems* *Prioritization and Focus* *Trade-offs and Balance in Resolution*	1	2	3	4	5
2.4 PERSONAL SKILLS AND ATTRIBUTES *Initiative and Willingness to Take Risks* *Perseverance and Flexibility* *Creative Thinking* *Critical Thinking* *Awareness of One's Personal Knowledge, Skills and Attitudes* *Curiosity and Lifelong Learning* [i] *Time and Resource Management*	1	2	3	4	5
2.5 PROFESSIONAL SKILLS AND ATTITUDES *Professional Ethics, Integrity, Responsibility and Accountability* [f] *Professional Behavior* *Proactively Planning for One's Career* *Staying Current on World of Engineer*	1	2	3	4	5

Circle one level of proficiency for each topic				
1. To have experienced or been exposed to	2. To be able to participate in and contribute to	3. To be able to understand and explain	4. To be skilled in the practice or implementation of	5. To be able to lead or innovate in

3 Communication

	1	2	3	4	5
3.1 TEAMWORK [d] *Forming Effective Teams* *Team Operation* *Team Growth and Evolution* *Leadership* *Technical Teaming*	1	2	3	4	5
3.2 COMMUNICATIONS *Communications Strategy* *Communications Structure* *Written Communication* *Electronic/Multimedia Communication* *Graphical Communication* *Oral Presentation and Inter-Personal Communications*	1	2	3	4	5

	1. To have experienced or been exposed to	2. To be able to participate in and contribute to	3. To be able to understand and explain	4. To be skilled in the practice or implementation of	5. To be able to lead or innovate in

4 OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT

4.1 EXTERNAL AND SOCIETAL CONTEXT [h] *Roles and Responsibility of Engineers* *The Impact of Engineering on Society* *Society's Regulation of Engineering* *The Historical and Cultural Context* *Contemporary Issues and Values* [j] *Developing a Global Perspective*	1	2	3	4	5
4.2 ENTERPRISE AND BUSINESS CONTEXT *Appreciating Different Enterprise Cultures* *Enterprise Strategy, Goals, and Planning* *Technical Entrepreneurship* *Working Successfully in Organizations*	1	2	3	4	5
4.3 CONCEIVING AND ENGINEERING SYSTEMS [c] *Setting System Goals and Requirements* *Defining Function, Concept and Architecture* *Modeling of System and Insuring Goals Can Be Met* *Development Project Management*	1	2	3	4	5
4.4 DESIGNING [c] *The Design Process* *The Design Process Phasing and Approaches* *Utilization of Knowledge in Design* *Disciplinary Design* *Multidisciplinary Design* *Multi-Objective Design (DFX)*	1	2	3	4	5
4.5 IMPLEMENTING [c] *Designing the Implementation Process* *Hardware Manufacturing Process* *Software Implementing Process* *Hardware Software Integration* *Test, Verification, Validation, and Certification* *Implementation Management*	1	2	3	4	5
4.6 OPERATING [c] *Designing and Optimizing Operations* *Training and Operations* *Supporting the System Lifecycle* *System Improvement and Evolution* *Disposal and Life-End Issues* *Operations Management*	1	2	3	4	5

Now, within each topic you may select sub-topics that should have a higher level of proficiency relative to the others in that topic and sub-topics that should have a lower proficiency. A "+" indicates one step up in the activity-based proficiency scale. A "-" indicates one step down. The number of "+"s must equal the number of "-"s.

2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES

2.1 ENGINEERING REASONING AND PROBLEM SOLVING [e]

2.1.1 Problem Identification and Formulation	+	-	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
2.1.2 Modeling	+	-	
2.1.3 Estimation and Qualitative Analysis	+	-	
2.1.4 Analysis With Uncertainty	+	-	
2.1.5 Solution and Recommendation	+	-	

Comments:

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2.2 EXPERIMENTATION AND KNOWLEDGE DISCOVERY [b]

2.2.1 Hypothesis Formulation	+	-	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
2.2.2 Survey of Print and Electronic Literature	+	-	
2.2.3 Experimental Inquiry	+	-	
2.2.4 Hypothesis Test, and Defense	+	-	

Comments:

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2.3 SYSTEM THINKING

2.3.1 Thinking Holistically	+	-	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
2.3.2 Emergence and Interactions in Systems	+	-	
2.3.3 Prioritization and Focus	+	-	
2.3.4 Trade-offs and Balance in Resolution	+	-	

Comments:

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2.4 PERSONAL SKILLS AND ATTRIBUTES

2.4.1 Initiative and Willingness to Take Risks	+	-	Choose two, one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
2.4.2 Perseverance and Flexibility	+	-	
2.4.3 Creative Thinking	+	-	
2.4.4 Critical Thinking	+	-	
2.4.5 Awareness of One's Personal Knowledge, Skills and Attitudes	+	-	
2.4.6 Curiosity and Lifelong Learning [i]	+	-	
2.4.7 Time and Resource Management	+	-	

Comments:

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2.5 PROFESSIONAL SKILLS AND ATTITUDES

2.5.1 Professional Ethics, Integrity, Responsibility and Accountability [f]	+	-	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
2.5.2 Professional Behavior	+	-	
2.5.3 Proactively Planning for One's Career	+	-	
2.5.4 Staying Current on World of Engineer	+	-	

Comments:

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3 Communication

3.1 TEAMWORK [d]

3.1.1 Forming Effective Teams	+	-	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
3.1.2 Team Operation	+	-	
3.1.3 Team Growth and Evolution	+	-	
3.1.4 Leadership	+	-	
3.1.5 Technical Teaming	+	-	

Comments:

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3.2 COMMUNICATIONS

3.2.1 Communications Strategy	**+**	**-**	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
3.2.2 Communications Structure	**+**	**-**	
3.2.3 Written Communication	**+**	**-**	
3.2.4 Electronic/Multimedia Communication	**+**	**-**	
3.2.5 Graphical Communication	**+**	**-**	

Comments:

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4 OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT

4.1 EXTERNAL AND SOCIETAL CONTEXT [h]

4.1.1 Roles and Responsibility of Engineers	**+**	**-**	Choose two, one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.1.2 The Impact of Engineering on Society	**+**	**-**	
4.1.3 Society's Regulation of Engineering	**+**	**-**	
4.1.4 The Historical and Cultural Context	**+**	**-**	
4.1.5 Contemporary Issues and Values [j]	**+**	**-**	
4.1.6 Developing a Global Perspective	**+**	**-**	

Comments:

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4.2 ENTERPRISE AND BUSINESS CONTEXT

4.2.1 Appreciating Different Enterprise Cultures	**+**	**-**	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.2.2 Enterprise Strategy, Goals, and Planning	**+**	**-**	
4.2.3 Technical Entrepreneurship	**+**	**-**	
4.2.4 Working Successfully in Organizations	**+**	**-**	

Comments:

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4.3 CONCEIVING AND ENGINEERING SYSTEMS [c]

4.2.1 Setting System Goals and Requirements	**+**	**-**	Choose one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.2.2 Defining Function, Concept and Architecture	**+**	**-**	
4.2.3 Modeling of System and Insuring Goals Can Be Met	**+**	**-**	
4.2.4 Development Project Management	**+**	**-**	

Comments:
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4.4 DESIGNING [c]

4.4.1 The Design Process	**+**	**-**	Choose two, one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.4.2 The Design Process Phasing and Approaches	**+**	**-**	
4.4.3 Utilization of Knowledge in Design	**+**	**-**	
4.4.4 Disciplinary Design	**+**	**-**	
4.4.5 Multidisciplinary Design	**+**	**-**	
4.4.6 Multi-Objective Design (DFX)	**+**	**-**	

Comments:
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4.5 IMPLEMENTING [c]

4.5.1 Designing the Implementation Process	**+**	**-**	Choose two, one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.5.2 Hardware Manufacturing Process	**+**	**-**	
4.5.3 Software Implementing Process	**+**	**-**	
4.5.4 Hardware Software Integration	**+**	**-**	
4.5.5 Test, Verification, Validation, and Certification	**+**	**-**	
4.5.6 Implementation Management	**+**	**-**	

Comments:
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4.6 OPERATING [c]

4.6.1 Designing and Optimizing Operations	**+**	**-**	Choose two, one or zero of these sub-topics to increase the proficiency level relative to the others in this topic. Then choose an equal number to reduce so the average remains the same.
4.6.2 Training and Operations	**+**	**-**	
4.6.3 Supporting the System Lifecycle	**+**	**-**	
4.6.4 System Improvement and Evolution	**+**	**-**	
4.6.5 Disposal and Life-End Issues	**+**	**-**	
4.6.6 Operations Management	**+**	**-**	

Comments:
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