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# **Integrating Pedagogy and Technology to Measure Program and Institutional Learning Outcomes at the University of Guelph Appendix**

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## Appendix A: Example Assignment Description Used in Proof of Concept

### ASSIGNMENTS 1, 2 and 3 (10%, 15% and 15%)

#### *Inquiry and Analysis, Information Literacy, Written Communication*

This semester, you are required to hand in three written assignments. For all of these written assignments, you are asked to assume the role of an exhibition planner at the Canada Science and Technology Museum in Ottawa. Along with classmates, you are preparing for next year's special exhibition: "Science and Technology: A History." The exhibition will feature three rooms, each filled with scientific and technological artifacts that have been important to the world of science and technology at various times. Each room will represent a particular time period in history:

Room 1. Prehistory and Antiquity (Prehistory to 5th century)

Room 2. The Middle Ages and the Renaissance (5th to 17th century)

Room 3. The Modern World (18th century to the present)

For each assignment, you will choose an artifact that you think should be featured in the room. This artifact can be an image, an object, a book, a film, or an art piece. You are asked to locate academic information on this artifact to construct an answer to the question: Why should the museum feature this particular artifact as part of its special exhibition? Your answer needs to be based on reliable information rather than opinion.

Each assignment should be around 700 words in length and include:

1. A title page
2. Sources of academic quality (at least 4)
3. Each source needs to be cited correctly using the Chicago, APA or MLA style of referencing (a handout on each style is available here: [http://www.lib.uoguelph.ca/assistance/writing\\_services/resources/handouts.cfm](http://www.lib.uoguelph.ca/assistance/writing_services/resources/handouts.cfm))
4. A description of the artifact. What is it called, where and when was it used, how was it used, by whom?
5. The answer to the question: Why should the museum feature this particular artifact as part of its special exhibition? (using your sources)

\*Please note: In organizing this exhibition, you should not be concerned with the legacy of an artifact throughout the centuries; rather, you will want to consider the historical context in which a particular artifact emerged and its impact on the society of its time.

## Appendix B: Analytic Rubric Used in Proof of Concept

Rubric Used in BAS Program						Score
<b>INFORMATION LITERACY:</b> Locates and uses information from a variety of resources and formats including visual representations	0–7.5 points: Virtually no relevant sources or very serious errors of fact.	7.5–9 points: Very little or largely irrelevant sources. Evidence taken out of context. Substantial errors of facts. Quotations are undigested or used as fillers. Incorrectly quoted or cited. Sources are very poor.	9–10.5 points: Excessive dependence on a single source. Sources used as affirmation of writer's viewpoint. Evidence taken out of context. Substantial omissions or irrelevancies and/or minor errors of fact. Quotations are undigested or used as fillers. Sources cited incorrectly or not always cited. Sources are poor.	10.5–12 points: Sources are generally good but there is a lack of variety or errors of omission. Most of the sources are cited correctly (either in Chicago, MLA or APA style), but they are deployed in limited ways as a simple affirmation of the writer's viewpoint. Some irrelevant data. The essay may need more sources or sources of better quality.	12–15 points: Sources are extensive, well-chosen and varied. They are quoted and cited correctly (either in Chicago, MLA or APA style). They support the arguments.	/15
<b>INQUIRY AND ANALYSIS:</b> Asks appropriate questions and finds evidence related to inquiry of material with a critical eye	0–10 points: No discernible analysis.	10–12 points: Little focused development. No answer to the question or the answer is based on misinterpretations. Reads like an encyclopedic entry.	12–14 points: The answer provided is fairly simplistic. There are too few insightful moments. May read more like an encyclopedic entry than an essay. May present some misreading.	14–16 points: The question is answered in a way that is mostly clear and focused, but the answer may lack sophistication. May read like a summary. Scope may be too ambitious. May make inconsistent connections between evidence and arguments.	16–20 points: The question is answered in a clear, focused and insightful way. The approach is interesting, original and limited in scope. Sources are deployed to support the claims being made.	/20

<b>WRITING COMMUNICATION:</b> Writes clearly and demonstrates general knowledge when describing an idea	0–7.5 points: Writing is nearly unintelligible. No discernible structure. Severe errors in grammar, spelling, and format that render the essay nearly incomprehensible.	7.5–9 points: Confusing or hard to understand. Disorganized structure and paragraphs. Frequent grammatical, spelling or format errors.	9–10.5 points: Understandably written but at times vague or choppy. May be simplistic or hard to read. Confusing or overly predictable structure. May read like a summary without a clear focus. Disorganized structure or paragraphs. Substantial grammatical, spelling, or format errors that detract attention from the content.	10.5–12 points: Clear and understandable prose. Might be weighed down by fancy diction meant to impress. Generally logical structure but can be unclear, disorganized or overly predictable at times. Some disorganized paragraphs. A few grammatical, spelling or format errors.	12–15 points: Clear and persuasive prose. Logical progression with strong and obvious links between points. Coherent and well-organized paragraphs. No grammatical, spelling or format errors.	/15
Total						/50

## Appendix C: Course Learning-outcomes Alignment Table

The following table presents a framework to communicate the constructive alignment of course-level learning outcomes with assessments, teaching and learning activities, as well as how the course-level learning outcomes fit within the context of the program or major. This framework can be used to support course design as well as to communicate this alignment to colleagues and students.

<b>Course-specific Learning Outcomes</b>	<b>Assessment Methods</b>	<b>Teaching and Learning Activities (TLA)</b>	<b>Alignment with Program- or Major-level Learning Outcomes</b>
<i>What will students know, value and be able to do by the end of the course?</i> Note: Courses typically have 5–8 learning outcomes.  By the end of the course, successful students will be able to:	<i>What assessment methods will provide evidence that students have achieved the LO?</i> <i>How will feedback be given to students regarding their achievement of the LO?</i> <i>What assessment methods will help to inform and improve student progress toward achieving proficiency with this LO?</i>	<i>What TLAs will students actively engage in as they progress towards this learning outcome? What TLAs will help to support students in their ability to achieve proficiency with the LO?</i> Note: these activities can occur both inside and outside of the classroom.	What program-level or major-level learning outcomes does this course-level learning outcome align with?  Note: Sometimes a course outcome may align with multiple program outcomes and vice-versa.
1)			
2)			
3)...			

Adapted from Boise State University Course Design Table: [https://sites.google.com/a/boisestate.edu/assessment/2012\\_plan/example-course](https://sites.google.com/a/boisestate.edu/assessment/2012_plan/example-course)

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## Appendix D: Establishing Your Course Context



### Course Context

#### Why is this course offered?

- What do you want students to say about this course in three years?
- Where does it fit within the engineering curriculum?
- How is it relevant to the learners, to other courses in the curriculum and to society?
- Why is it important for students' personal, professional and academic development?

Write a brief description (3–5 sentences) of *the importance and relevance* of this course that you could use to describe the course to incoming students or a faculty member from another discipline.

## Appendix E: Assessing Student Progression of Learning: Introduce, Reinforce, Master



As a group, you will be assigned one of the following three definitions to review in the context of the University of Guelph Engineering curriculum.

Record key ideas on a piece of flip chart paper. Be prepared to share the key ideas with your colleagues.

Think about the following guiding questions as you revise:

- At this level of sophistication, what learning activities and experiences are students engaged in?
- What are engineering students able to demonstrate at this level of sophistication?
- How could this definition further reflect the engineering curriculum?

**1. Introduce** – Key ideas, concepts or skills related to the learning outcome are introduced and demonstrated at an introductory level. Instruction and learning activities focus on basic knowledge, skills and/or competencies and entry-level complexity.

**2. Reinforce** – Learning outcome is reinforced with feedback; students demonstrate the outcome at an increasing level of proficiency. Instruction and learning activities concentrate on enhancing and strengthening existing knowledge and skills, as well as expanding complexity.

**3. Master** – Students demonstrate learning outcome with high level of independence, expertise and sophistication expected upon graduation. Instructional and learning activities focus on and integrate the use of the content or skills in multiple levels of complexity.

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Definitions of Introduce, Reinforce and Master are adapted from <http://www.ced.csulb.edu/offices/assessment-office/creating-curriculum-map> and Veltri, N. and Matveev, A. (2011). Curriculum mapping as a tool for continuous improvement of IS curriculum. *Journal of Information Systems Education* 22(1), 31–42.



## Appendix F: Engineers Canada Consultation Group on Engineering Instruction and Accreditation – Graduate Attributes

3.1.1 A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

3.1.2 Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

3.1.3 Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.

3.1.4 Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

3.1.5 Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

3.1.6 Individual and team work: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

3.1.7 Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

3.1.8 Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

3.1.9 Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal and cultural aspects of society, the uncertainties in the prediction of such interactions, and the concepts of sustainable design and development and environmental stewardship.

3.1.10 Ethics and equity: An ability to apply professional ethics, accountability and equity.

3.1.11 Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

3.1.12 Lifelong learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

Engineers Canada Consultation Group on Engineering Instruction and Accreditation  
January 7, 2016 Webinar

## Appendix G: Mapping Outcomes to Graduate Attributes



Questions to consider while mapping course outcomes to graduate attributes

- What attributes do the learning outcomes in this course align with? How?
- Where in the graduate attribute list does your course have the highest impact? Why?
- How could students understand these attributes within the context of this course?

## Appendix H: Mapping Outcomes to Graduate Attributes



<b>A: Course Learning Outcome</b>	<b>B: Assessing Course Learning Outcomes</b>	<b>C: Graduate Attributes, Indicators</b>	<b>D: Assessing Graduate Attributes included in LOA Project</b>	<b>E: Level of Sophistication</b>	<b>F: Additional Contextual Information</b>
<i>What will students know, value and be able to do by the end of the course?</i> By the end of the course, successful students will be able to:	What assessment strategy will be used to evaluate this learning outcome?	What graduate attributes and/or indicators best align with this learning outcome?	What assessment strategy will be included in CourseLink that aligns as part of the LOA project?  Note: not all learning outcomes will be assessed within the context of the LOA project.	Within the context of the engineering curriculum, at what level of sophistication will this learning outcome be assessed?	Why did you classify the level of sophistication as L, R or M?  Is there any additional context you would like to provide?
ENGG*41x0 – Engineering Design IV.  Concisely articulate the design results in a poster	Poster Presentation	GA 6 – Communication GA 7 – Individual & Team Work	External hard copy rubric is used to grade the poster presentation. Marks are entered into the CourseLink.	Introduce (I), Reinforce (R)	Posters are introduced in the lecture materials and reinforced through group discussions with their adviser. More poster presentations would need to be completed to reach Master (M) level.
ENGG*2120 – Materials Science  Describe the general properties of key engineering materials: metals, ceramics, polymers, and composites	Project report, quizzes, midterm	GA 1 – Knowledge Base GA 3 - Investigation	Project rubric assesses knowledge of material properties and ability to develop experiments to identify materials based on their properties. Rubric delivered through CourseLink	Introduce and Reinforce	Lectures introduce the properties of each class of materials, students will reinforce these ideas through the material identification project.

## Appendix I: Program-wide Learning-outcomes Coverage and Assessment

	Graduate Attribute Content												
	1				2					3			
	Knowledge Base				Problem Analysis					Investigation			
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4
Course 1	T;A	T;A	T;A									T;A	nT;A
Course 2			T;A					T;A					
Course 3	T;A		T;A										
Course 3	T;A							T;A	T;A				
Course 3	T;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A				
...										T;A	T;A	T;A	T;A
			T;A		T;A			T;A			T;A	T;A	
	T;A												
	T;A		T;A					T;A	T;A				
	T;A	T;A	T;A		T;A			T;A				T;A	T;A
		T;A	T;A				nT;A	T;A	T;A			T;A	T;A
			T;A					T;A				T;A	
			T;A		T;A	T;A	T;A	T;A	T;A		T;A	T;A	
	T;A		T;A										
	T;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A				
	T;A		T;A		T;A	T;A	T;A	T;A	T;A				
	T;A		nT;A		T;A			T;A	T;A				
		nT;A	T;A		T;A	T;A		T;A	T;A				T;A
	T;A	T;A	T;A		nT;A	nT;A	nT;A	nT;A	nT;A			T;A	nT;A
			T;A			T;A		T;A					
	T;A							T;A	T;A				
	T;A							T;A	T;A				
		T;A	T;A									nT;A	nT;A
	T;A	T;A	T;A		T;A			T;A	T;A				
	T;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A
	nT;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A				
			T;A		T;A	T;A	T;A	T;A					
	T;A		T;A		T;A	T;A		T;A	T;A				
			T;A		nT;A	nT;A	nT;A	nT;A	T;A	nT;A	nT;A	nT;A	nT;A
	T;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A
	T;A	nT;A	T;A		nT;A	nT;A	nT;A	nT;A	nT;A		T;A	T;A	T;A
	T;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A
			T;A										
			T;A		T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A	T;A
										nT;A	nT;A	nT;A	nT;A
	nT;A	T;A	T;A		T;A	T;A	T;A	T;A	T;A	nT;A	nT;A	nT;A	nT;A
			T;A										

Taught/Assessed

Taught; Assessed
Not Taught; Assessed
Not Taught; Not Assessed

## Appendix J: Program-wide Mapping of the Sophistication of Learning Outcomes

Learning Outcome Progression Level														
Course 1	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	
Course 2	I	I	I										I	I
Course 3			I					I						
Course...	I		I						I					
	RM							IRM	IRM					
	IR	IR	IR		IR	IR	IR	IR	IR					
										I	I	I	I	I
			IR		IR			R				I	I	
	IR		I											
	RM		R					IRM	IRM					
	I	I	I		I			I				I	I	
	R	IR	IR				IR	IR	IR			IR	IR	
			IR					R				IR		
	IR		IRM		R	I	I	IRM	I		I	I		
	I		I					I						
	IR	IR	IR		IR	I	I	IR	I					
	R	I	IR		R	R	R	R	R					
	IR		R		IR			IR	IR					
		R	IR		IR	I	IR	IR	IR		IR	IR	I	
	IR	R	IR		R	R	R	R	R			R	R	
					R									
	RM							IRM	IRM					
	IR							IR	IR					
		IR	IR											
					IRM			IRM	IRM					
	M	M	IRM		R	R	R	R	R	R	R	R	R	R
		R	IRM		RM	R	R	R	IR					
			IR		I	I	I	I	I					
	RM		R		IR	IR		R	R					
						M	M	M	M					
		M	IRM		RM	R	R	R	R	I	I	I	I	
	R		IR		I	I	I	I	I		R	R	R	
	M	M	IRM		R	R	R	R	RM	R	R	R	R	
			IR											
			IRM		IR	IRM	IRM	IRM	IR	IR	IR	IR	IR	
	M	M	M		M	M	M	M	M	M	M	M	M	
	R	R	IRM		R	R	R	R	R	I	I	I	I	
			IR											

Progression Level

I	Introduce
R	Reinforce
M	Master

## Appendix K: Engineering Experience Record Guide

### Experience Requirements

Applicants must demonstrate at least 48 months of verifiable, acceptable engineering experience, of which at least 12 months must be acquired in a Canadian jurisdiction under the supervision of a licensed professional engineer.

You may be given a maximum of 12 months of experience credit for a post-graduate engineering degree or degrees in the same engineering discipline as your undergraduate degree. You may also be eligible for up to 12 months of pre-graduation engineering experience provided that the experience is acquired after completion of half of your undergraduate studies and it is documented and approved by your supervisor. Pre-graduation experience forms are available on the PEO website.

### *Acceptable Engineering Experience*

Satisfactory engineering experience is that which complements your academic engineering training and builds on the knowledge that you gained in university. Activities must involve: engineering design; design review/modifications; or problem solving that requires engineering analysis. This experience should also provide for the development of responsibility, judgment, communication skills and self-confidence.

The following are the five elements of satisfactory engineering experience for licensure purposes. A substantial exposure to the first two, “application of theory” and “practical experience” is mandatory while a reasonable exposure to the remaining elements is sufficient. A complete lack of exposure to any one of these areas may render the applicant unsuitable for licensure.

- **Application of theory** – analysis, design, synthesis, devising testing methods, implementation methods.
- **Practical experience** – function of components as part of a larger system, limitations of practical engineering, significance of time in the engineering process, knowledge and understanding of codes, standards, regulations and laws.
- **Management of engineering** – planning, scheduling, budgeting, supervision, project control, risk assessment.
- **Communication skills** – written work, oral presentations, and presentations to the general public.
- **Social implications of engineering** – determining the value or benefits of the engineering work to the public, putting appropriate safeguards in place, relationship between the engineering activity and the public, role of regulatory agencies.

All of the above noted factors are taken into account when assessing the final experience record and the application for licensure. The simple passage of time is not sufficient; the **quality** of the experience is very important.

### *How to Create Your Experience Record*

To assist with the PEO review and help you ensure that your experience record provides adequate information it is suggested that your record be organized as follows:

- Complete the **Experience Record Form** (including the company name, location and the employment dates (month and year). Periods of absence from employment (traveling, unemployed) should also be listed with dates
- For each position about which you are reporting give us a small paragraph describing your job responsibilities with an emphasis on the engineering duties
- Describe how the work experience obtained in that position meets each of the five criteria (application of theory, practical experience, management of engineering, communication skills and knowledge of the social implications of engineering)

#### **When describing your engineering activities:**

- Focus on what **you** did as it relates to each of the five engineering criteria. Structure the description to include not only **WHAT** you did, but **HOW** you did it and **WHY** you did it. You may use the format: “I did...using...in order to...”
- Be specific about what **you** did as opposed to the work of the team. “I determined the heat load....”
- Provide sufficient information about the complexity of the situation.

### *Referees*

A minimum of three referees is required to verify your engineering experience. One must be your direct supervisor, who may or may not be a professional engineer. One of the other two referees must be a professional engineer who can comment directly on your work for a minimum of 12 months. If you have worked for more than one employer, over the applicable work period, please supply the pertinent information about your direct supervisor from each place of employment and at least one professional engineer referee who can comment on a minimum of 12 months of experience.

We will require the name and complete mailing address (or email address) for each referee. Please make sure that you provide reliable contact information as we will not track down your referees for you.



PEO reserves the right to interview an applicant whose experience record and/or referee statements are not sufficient to complete our assessment. **EXPERIENCE RECORD FORM** **Current Date:**

**Name:** \_\_\_\_\_ **File:** \_\_\_\_\_

**Telephone (H):** (    ) \_\_\_\_\_ **Email Address (H):** \_\_\_\_\_

**Telephone (B):** (    ) \_\_\_\_\_ **Email Address (B):** \_\_\_\_\_

#### ENGINEERING EXPERIENCE SUMMARY

**Company Name and Address (include country)**

**Length of Employment**

**Start date (mm, yyyy) to end date (mm, yyyy)**

**Position Title**

**Job Responsibilities and Engineering Duties**

*Provide a brief description of your engineering duties.*

**Application of Theory**

*Describe how you have applied engineering fundamentals in analysis, design, synthesis, testing methods and implementation methods.*

**Practical Experience**

*Describe your practical engineering experience in relation to the function of components as part of a larger system, limitations of practical engineering, significance of time in the engineering process, knowledge and understanding of codes, standards, regulations and laws*

**Management of Engineering**

*Describe situations involving planning, scheduling, budgeting, supervision, project control and risk assessment.*

**Communication Skills**

*Describe how you communicated your engineering ideas through written work, oral presentations and presentations to the general public.*

**Knowledge of the Social Implications of Engineering**

*Describe situations involving the benefits of the engineering work to the public, safeguards, the relationship between the engineering activity and the public, and the role of regulatory agencies.*

## Appendix L

**Table 5: Summary Table of Number of Program Assessments Mapped to Graduate Attributes Across 45 courses in the Engineering Program Curriculum**

Indicator	Total number of mapped assessments
Knowledge base	132
Problem analysis	184
Investigation	105
Design	122
Use of engineering tools	119
Individual and team work	7
Communication skills	86
Professionalism	9
Impact of engineering on society and environment	43
Ethics and equity	5
Economics and project management	78
Lifelong learning	19

Table 6 – Portion of program mapped assessments table – showing exemplars of mapped indicators, contributing courses and origin of assessment data (e.g., numeric mark or rubric) from the Winter 2017 Graduate Attribute Assessment Summary Table for the School of Engineering													
		Course 1		Course 2		Course 3		Course 4		Course 5...		...Course 45	
Indicator	# of mapped assessments	Numeric	Rubric	Numeric	Rubric	Numeric	Rubric	Numeric	Rubric	Numeric	Rubric	Numeric	Rubric
<b>1. Knowledge base</b>	<b>132</b>												
1.1 Recall, describe and apply fundamental mathematical principles and concepts	15			2		2						etc.	etc.
1.2 Recall, describe and apply fundamental concepts and principles in natural sciences	5			1				1		3		etc.	etc.
1.3 Comprehend and apply fundamental engineering concepts	48			1		2		13		3		etc.	etc.
1.4 Comprehend and apply program-specific engineering concepts	64											etc.	etc.
<b>2. Problem analysis</b>	<b>184</b>												
2.1 Formulate a problem statement in engineering and non-engineering terminology	27									3		etc.	etc.
2.2 Construct a conceptual framework	27									3		etc.	etc.
2.3 Identify, organize and justify appropriate information	32									3		etc.	etc.
2.4 Execute an engineering solution	57			6						3		etc.	etc.
<b>3. Investigation</b>	<b>105</b>												
3.1 propose and test working hypothesis...	19...											etc.	etc.
	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.



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