INTRODUCTION
In 1997 the Canadian Academy of Engineering (1) published a document that reviewed the state of Engineering Education in Canada. This was followed, in 1999 (2) by a second study that suggested how programs should adapt to meet future needs. Their first recommendation was that “Engineering faculties should ensure that breadth of learning, beyond the technical aspects of the specialist engineering discipline, is a major threat in engineering education.” Since then many studies have echoed this recommendation including the National Academy of Engineering in 2005 (7), Sheppard, et al in 2009 (9) and the Royal Academy of Engineering 2010 (8).

Current pressures suggest curriculum change is necessary. CDIO (4), a group of academic engineers with industry support, suggest that “Engineering education and real-world demands on engineers have in recent years drifted apart.” Douglas, et al (6), from their perspectives as engineers within Sun Microsystems, suggest that “New requirements are encroaching on the traditional tasks of engineering.”. From a more philosophical perspective, Civil Engineer Frederick Clark (5) suggested that “The engineer must be a philosopher enough to know what to believe, humanist enough to know what to desire, and a workman enough to know what to do.”

In 2010, probably in response to these pressures, the Canadian Engineering Accreditation Board (3) introduced new accreditation requirements. These requirements must be meet by 2014. There are two distinguishing features to these new requirements. First, the program reviews will assess program “outcomes” in addition to the traditional assessment of inputs. Second, graduates are expected to possess twelve specific “Attributes”. The first seven of these “Attributes”; A knowledge base for engineering, Problem analysis, Investigation, Design, Use of engineering tools, Individual and team work, and Communication skills reflect the focus of past CEAB requirements. However, the later five; Professionalism, Impact of engineering on society and the environment, Ethics and equity, Economics and project management, and Life-long learning, focus more on the recommended changes cited by others. It is clear that these so called “soft skills” must receive more attention.

THE DELIVERY PROBLEM
The fundamental purpose of engineering education in Canada is to produce graduates who are “academically qualified” to become Engineers-in-Training. Universities have addressed this requirement by focussing on technical education in depth, often featuring three or four levels of concentration in specific technical areas. This has also supported the research agenda within academic Curricula are crowded and demanding. Introduction of new material is difficult within traditional “four year” programs.

A further curriculum design constraint is the CEAB imposition of minimum inputs for Mathematics and Natural Sciences, Engineering Science and Engineering Design, and Complementary Studies which amount to almost 80% of the minimum required classroom input. Some new material could be included in the Complementary Studies area, but the inference in the “Attribute” descriptions suggests Engineering input. Some “soft skills” can be incorporated into technical classes, but then it is simply an “add on”, not a focus. The problem boils down to finding a way to introduce new material within realistic time constraints and without serious negative impact on the core curriculum.

A POTENTIAL SOLUTION
Most courses in Engineering are offered in a pattern of three hours of lecture and one laboratory/tutorial session per week. Over a term that runs from 10 to 13 weeks, this allows study in reasonable depth. If one class slot (three lecture hours) per term was set aside for Engineering elective courses associated with the later five “Attribute” subject areas it would provide an opportunity to introduce this type of material without major impact on the more traditional inputs. The prime competition for this lecture time would be advanced technical electives that go beyond most undergraduate needs.

However, a simple substitution of an “Attributes” class for an Engineering Science or Design class would not address the breadth of new material identified as necessary, and it would require that any selected topic be studied in depth. If we accept that CEAB’s intention is to have us provide students with an understanding of some basic non-technical concepts that are fundamental to becoming an engineer, the three lecture hours per week could be devoted to three different concepts in three different “one credit” courses. These courses would be developed respecting the New Oxford dictionary definition of concept as “an abstract or general idea inferred or derived from specific instances.”.

Under this proposed format, a Concept Course would provide instructors with from 10 to 13 hours, depending on the length of the term, in which to assist students in gaining a thorough understanding of the concept in question. Series of Concept Courses would provide a wide, and individualized philosophical base to complement the technical understanding that students now gain.

From an instructor’s perspective, teaching a Concept Course would require rethinking how the material would be delivered. The one week “time lapse” between classes could cause problems in maintaining continuity. As well, given that the subject matter is neither formula nor calculation based, it would likely be necessary to adapt teaching techniques that are more commonly employed in Arts and Business faculties. Some would see this as an opportunity, others would disagree.

Format notwithstanding, the basic idea is to provide dedicated classroom time for a breadth of “soft skill” learning opportunities. Topics like risk, professionalism, engineering ethics, design limitations, historic failures, engineering history would all serve to broaden the perspectives of new graduates.

CONCLUSIONS
Fundamentally the Concept Course idea is an attempt to create a format in which we can help our students begin to understand Clark’s (5) suggestion that “The engineer must be a philosopher enough to know what to believe, humanist enough to know what to desire, and a workman enough to know what to do.”. If we are to reach that goal and if we are to meet CEAB’s new requirements, we need to change some fundamentals in curriculum development. Our “customers”, the profession, are telling us we need to adapt our product, engineering graduates, to a changing market. Concept Course may assist in accomplishing that adaptation.

REFERENCES
1. Canadian Academy of Engineering, Engineering Education in Canadian Universities, January 1997
2. Canadian Academy of Engineering, Evolution of Engineering Education in Canada , December 1999
3. Canadian Engineering Accreditation Board, 2010 Accreditation Criteria and Procedures, Canadian Council of Professional Engineers. 2010
4. CDIO <http://www.cdio.org/benefits-cdio>

THE CONCEPT OF CONCEPT COURSES
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