# Indicators should:

# Be measureable and meaningful

# Have: content, context, and verb

# Be useful to YOU to identify key expectations of students.

# Possible subject topics for graduate attribute indicators

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|  | **Attribute** | **Starting points for creating indicators…** |  | **Attribute** | **Starting points for creating indicators…** |
| 1 | Knowledge | Key concepts/Threshold concepts in discipline  Process of developing knowledge in the discipline | 7 | Individual and team work | Approaches to leadership  Behavioural approaches  Conflict resolution  Giving and receiving feedback |
| 2 | Problem analysis | Closed and open-ended problem solving  Convergent and divergent thinking  Critical thinking | 8 | Professionalism | Legal and regulatory framework for engineering  Professional obligations  Safety  Assessing and managing risk |
| 3 | Investigation | Design of experiment  Analysis and interpretation of data  Error estimation  Drawing conclusions from investigation | 9 | Impact on society and environment | Sustainability  Lifecycle analysis  Social impact of engineering |
| 4 | Engineering tools | Selection of tools  Application of tools  Uncertainty associated with tools | 10 | Ethics and equity | Codes of ethics  Ethical framework for decision making  Working with diverse groups  Equity |
| 5 | Design | Design process stages (problem definition, preliminary design, …)  Stakeholders, safety, social impact  General engineering design tools  Discipline specific design | 11 | Economics and project management | Economic tools  Business plans  Project management  Change management |
| 6 | Communications | Written, oral, graphical communications  Writing process stages  Formal and informal writing | 12 | Lifelong learning | Self-regulation (monitoring, evaluating, and improving approaches to learning)  Information literacy  Opportunities for ongoing professional development |

**Taxonomies of Learning Outcomes**

**Bloom’s (Anderson’s) Taxonomy of Cognitive Learning Outcomes**

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| **Knowledge (Remembering)** – Retrieving, recalling or recognizing knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material.  Sample verbs: define, recall, identify, name, recognize, list, repeat, duplicate, label, match, order, reproduce, state  Examples: state specific facts, define terminology, recall sequences and procedures, state rules and principles, recall equations, put a list in order, match term to definition, etc. | | |
| **Comprehension (Understanding)** – The ability to grasp or construct meaning.  Sample verbs: paraphrase, identify, illustrate, describe, explain, differentiate, classify, give example, indicate, locate, rewrite, restate, summarize, interpret  Examples: state in your own words, explain a principle or concept, illustrate with an example, explain the meaning of each term in an equation, differentiate between two methods, draw a diagram to describe, etc. | | |
| **Application (Applying** ) -- Carrying out or using a procedure. Ability to implement material in concrete situations.  Sample verbs: apply, employ, determine, calculate, formulate, show, develop, use, demonstrate, compute, derive, predict, produce, solve, write, implement.  Examples: use a principle or concept to calculate, solve a problem using a known method, apply a formula to determine a result, apply principles of professional writing, implement a lab procedure. | | |
| **Analysis (Analyzing)** – Breaking material or concepts into parts, determining how parts work and relate, and relate back to overall structure and organization.  Sample verbs: analyze, compare, contrast, investigate, examine, discriminate, deduce, explore.  Examples: analyze a system, examine a structure, explore an idea , critically dissect a design or solution. | **Synthesis (Creating** )– Ability to put parts together to form a coherent and unique whole. Arrange elements in a new way.  Sample verbs: design, compose, produce, invent, assemble, construct, create, document, write, relate, propose, develop, plan, generate.  Examples: write an report, design a product or system, plan a process, develop a unique solution. | **Evaluation (Evaluating)** – Making judgments based on criteria and standards. Ability to critique the value of an idea for a purpose.  Sample verbs: evaluate, judge, assess, compare, validate, argue, decide, choose, appraise, rate, conclude, select, criticize, estimate, infer, deduce, defend, justify.  Examples: evaluate alternative solutions or methods, critique a design, create a credible argument. |

**Other verbs that might be useful**: arrange, recognize, classify, convert, distinguish, predict, review, change, modify, operate, prepare, schedule, sketch, use, diagram, discriminate, model, test, arrange, collect, combine, comply, generate, manage, reconstruct, draw…

**Verbs to avoid if possible**: know, understand, learn, believe, ….. Any verb that is vague or impossible to assess. You want outcomes that result in an product or performance that can be assessed.

**Psychomotor Taxonomy (Dave):**

* **Imitation** — Observing and patterning behavior after someone else.
* **Manipulation** — Being able to perform certain actions by following instructions and practicing. **Precision** — Refining, becoming more exact. Few errors are apparent.
* **Articulation** — Coordinating a series of actions, achieving harmony and internal consistency.
* **Naturalization** — Having high level performance become natural, without needing to think much about it. Taken from: <http://www.nwlink.com/~donclark/hrd/bloom.html>

**Affective Taxonomy**

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| **Receiving** is being aware of or sensitive to the existence of certain ideas, material, or phenomena and being willing to tolerate them. Examples include: to differentiate, to accept, to listen (for), to respond to. |
| **Responding** is committed in some small measure to the ideas, materials, or phenomena involved by actively responding to them. Examples are: to comply with, to follow, to commend, to volunteer, to spend leisure time in, to acclaim. |
| **Valuing** is willing to be perceived by others as valuing certain ideas, materials, or phenomena. Examples include: to increase measured proficiency in, to relinquish, to subsidize, to support, to debate. |
| **Organization** is to relate the value to those already held and bring it into a harmonious and internally consistent philosophy. Examples are: to discuss, to theorize, to formulate, to balance, to examine. |
| **Characterization** by value or value set is to act consistently in accordance with the values he or she has internalized. Examples include: to revise, to require, to be rated high in the value, to avoid, to resist, to manage, to resolve. |