Bachelor of Mechanical Engineering with Honours

Program Educational Objective (PEO)

(*Career and professional accomplishment that the program is preparing graduates to achieve [Felder & Brent, 2005]*)

Our graduates are expected to achieve one or more of the following PEOs within five years of graduation from our program:

1. Excel in engineering practices in various industries.
2. Establish themselves as leaders in their professional careers.
3. Earn an advanced degree or professional certification.

Program Outcome (PO)

(*Statement of knowledge, skills and behaviours that students are expected to acquire by the time they graduate [Felder & Brent, 2005]*)

PO	Category	Description	Knowledge Profile (KP)
PO1	Engineering knowledge	Apply knowledge of mathematics, natural science and engineering fundamentals to solve complex engineering problems particularly in mechanical engineering.	KP1 to KP4
PO2	Problem Analysis	Identify, formulate and analyze complex engineering problems to an extent of obtaining meaningful conclusions using principles of mathematics, science and engineering.	KP1 to KP4
PO3	Designing Solutions	Design solutions for complex engineering problems and design systems, components or processes to within the prescribed specifications relevant to mechanical engineering with appropriate considerations for public health and safety, society and environmental impact.	KP5
PO4	Investigation	Investigate complex mechanical engineering problems using research-based knowledge and research methods to provide justified conclusions.	KP8
PO5	Modern Tool Usage	Create, select and apply appropriate techniques, resources, and modern engineering and computational tools to complex engineering problems with an understanding of the limitations.	KP6
PO6	The Engineer and Society	Apply appropriate reasoning to assess contemporary societal, health, safety and legal issues to establish responsibilities relevant to professional engineering practice and solutions to complex engineering problems.	KP7
PO7	Environment and Sustainability	Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.	KP7

PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	KP7
PO9	Individual and Team Work	Function successfully and efficiently as an individual, and as a member or leader in multi-disciplinary teams.	-
PO10	Communication	Communicate effectively both orally and in writing on complex engineering activities with the engineering community and society.	-
PO11	Project Management and Finance	Apply knowledge and understanding of project management and finance to engineering projects.	-
PO12	Lifelong Learning	Recognize the need for, and is capable to undertake life-long learning in the broadest context of knowledge and technological change.	-

Reviewed and approved by the school board on March 06, 2019.
Reference: *EAC Standard 2020*

Knowledge Profile (KP)

The list of KP define indicated volume of learning and attributes against which graduates must be able to perform. The list is used to extend and clarify the definition of the Graduate Attributes (see the PO list above). The list of KP, extracted verbatim from the 2013 IEA document is:

KP	Category	Description	Related PO
KP1	Natural Sciences	A systematic, theory-based understanding of the natural sciences applicable to the discipline.	PO1, PO2
KP2	Mathematics	Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.	PO1, PO2
KP3	Engineering Fundamentals	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	PO1, PO2
KP4	Specialist Knowledge	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	PO1, PO2
KP5	Engineering Design	Knowledge that supports engineering design in a practice area.	PO3
KP6	Engineering Practice	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	PO5
KP7	Societal Roles	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.	PO6, PO7, PO8
KP8	Research Literature	Engagement with selected knowledge in the research literature of the discipline.	PO4

Reference: *Graduate Attributes and Professional Competencies (Version 3), International Engineering Alliance (2013)*

Range of Complex Engineering Problem (CP)

The list of CP clarifies the definition of Complex Engineering Problem by establishing seven range, or attributes of problem solving. Based on this list of CP, the attributes of a Complex Engineering Problem is that it must have CP1 and some or all of CP2 to CP7.

CP	Attributes	Description
CP1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of KP3, KP4, KP5, KP6 or KP8 which allows a fundamentals-based, first principles analytical approach.
CP2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.
CP3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.
CP4	Familiarity of issues	Involve infrequently encountered issues.
CP5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.
CP6	Extent of stakeholder involvement and conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.
CP7	Interdependence	Are high level problems including many component parts or sub-problems.

Reference: Graduate Attributes and Professional Competencies (Version 3), International Engineering Alliance (2013)

Range of Complex Engineering Activities (CA)

There are five attributes of activities student can be involved in when solving Complex Engineering Problem, as defined in the 2013 IEA document for Washington Accord graduates. A Complex Engineering Activity or Project is that which has some or all of the following attributes:

CA	Attributes	Description
CA1	Range of resources	Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies).
CA2	Level of interactions	Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.
CA3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.
CA4	Consequences to society and the environment	Have significant consequences in a range of contexts. Characterized by difficulty of prediction and mitigation.

CA5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.

Reference: Graduate Attributes and Professional Competencies (Version 3), International Engineering Alliance (2013)

Learning Domains (LD)

The LD are based on the three learning domains, i.e., cognitive (C), affective (A), and psychomotor (P), and their levels of learning are listed below:

Six levels of the Cognitive (C) Domain (**Anderson and Krathwohl's Taxonomy 2001**)

Bloom's Levels	Level of Learning	Characteristics of Learning	Bloom's Action Verbs (Example)
C1	Remembering	Recognizing and recalling relevant knowledge from long term memory.	List, Identify, Outline, Define, Arrange, Select, State, Match, Name, Recognise, Label, Know, Recall, Reproduce
C2	Understanding	Constructing meaning from oral, written and graphic messages through interpreting, classifying, summarizing, inferring, comparing and explaining.	Explain, Describe, Interpret, Distinguish, Summarize, Paraphrase, Illustrate, Convert, Discuss, Estimate, Classify, Rephrase, Translate, Show, Relate, Comprehend, Defend, Extend, Generalize, Gives an example, Infer, Rewrite
C3	Applying	Carrying out or using a procedure through executing or implementing.	Apply, Calculate, Solve, Use, Compute, Demonstrate, Construct, Sketch, Write, Discover, Manipulate, Modify, Operate, Prepare, Produce, Run
C4	Analyzing	Breaking Material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing.	Analyze, Analyse, Compare, Derive, Categorize, Contrast, Assume, Conclusion, Examine, Simplify, Break down, Diagram, Deconstruct, Differentiate, Discriminate, Separate
C5	Evaluating	Making judgments based on criteria and standards through checking and critiquing.	Determine, Optimize, Evaluate, Agree, Appraise, Assess, Choose, Criticize, Decide, Influence, Judge, Justify, Measure, Opinion, Recommend, Prove
C6	Creating	Putting elements together to form a coherent or function whole; recognizing elements into a new pattern or structure through generating, planning or producing.	Formulate, Design, Create, Adapt, Build, Change, Combine, Compile, Develop, Propose, Predict, Conclude

Five levels of the Affective (A) Domain (Krathwohl, Bloom, Masia 1973)

Bloom's Levels	Level of Learning	Characteristics of Learning	Bloom's Action Verbs (Example)
A1	Receiving Phenomena	Awareness, willingness to hear, selected attention.	Ask, choose, describe, follow, identify, locate, name, select, reply, use, acknowledge, attentive, courteous, dutiful, gives, listens, understands
A2	Responds to Phenomena	Active participation, interaction or response to new information or experiences.	Answer, assist, aid, compile, conform, discuss, help, label, perform, practice, present, read, recite, report, select, tell, write
A3	Valuing	Value or worth a person attaches to particular object, phenomenon or behavior. This ranges from simple acceptance to more complex state of commitment.	Complete, demonstrate, differentiate, explain, follow, form, initiate, join, justify, propose, read, share, study, work, appreciates, cherish, treasure, invites, respect
A4	Organization	Incorporating new information or experiences to existing system.	Adhere, alter, arrange, combine, compare, complete, defend, formulate, generalize, identify, integrate, modify, order, organize, prepare, relate, synthesize
A5	Internalizes Values (Characterization)	Value system that controls their behavior. The behavior is pervasive, consistent, predictable and most importantly, characteristic of the learner	Act, discriminate, display, influence, listen, modify, perform, practice, propose, qualify, question, revise, serve, solve, verify, use

Seven levels of the Psychomotor (P) Domain (Simpson, 1972)

Bloom's Levels	Level of Learning	Characteristics of Learning	Bloom's Action Verbs (Example)
P1	Perception (awareness)	Uses senses organs to obtain cues to guide action: ranges from awareness of stimulus to translating cue perception into action.	Choose, describe, detect, differentiate, distinguish, identify, isolate, relate, select, separate
P2	Set	Readiness to take action: includes mental, physical and emotional set.	Begin, display, explain, move, proceed, react, respond, how, start, volunteer
P3	Guided Response	Knowledge of the steps required to perform a task: includes imitation and trial and error.	Copies, traces, follows, react, reproduce, responds
P4	Mechanism (basic proficiency)	Perform tasks in a habitual manner: with a degree of confidence and proficiency.	Assembles, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches

P5	Complex Overt Response (Expert)	Skill performance of motor acts involving complex patterns of movement.	assembles, builds, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches
P6	Adaptation	Modifies movement patterns to account for problematic or new situations.	Adapt, alter, chance, rearrange, reorganize, revise, vary
P7	Origination	Creating new movement patterns to account for problematic or new situations; creates new tasks that incorporate learned ones.	Arranges, builds, combines, composes, constructs, creates, designs, initiate, makes, originates