(Please do not distribute this document beyond the scope of the Innovation Portal Pilot Project. This rubric will be put through some initial trial studies and then released for public use by the university's research team)

Engineering Design Process Portfolio Rubric

About the Portfolio

The Engineering Design Process Portfolio is intended to document the process leading to an original attempt to design a product, process, or method to provide the best and most optimal solution to a genuine and meaningful problem. In essence, the portfolio should be a detailed account or "biography" of a project and the thought processes that inform that project. Besides narrative and explanatory text, entries may include (but need not be limited to) drawings, schematics, photographs, notebook and journal entries, transcripts or summaries of conversations and interviews, and audio/video recordings. Such entries are likely to be necessary in order to convey accurately and completely the complex thought processes behind the planning, implementation, and self-evaluation of the project.

The portfolio should capture the mathematics and science principles used to predict outcomes throughout the design process. Trial and error demonstrations are not rigorous enough to show mastery of fundamental concepts central to engineering design. In addition, the portfolio should document three overarching facets of the design process: reflection, iteration, and articulation of limitations.

Reflection: A well-documented design process conveys the thinking that informs each step, and explains the bases for observations, interpretations, actions and decisions. Reflection is essential to the continuous improvement that should be realized through the design process itself.

Iteration: The nature of engineering design is that all of the answers are not known before the design process begins, but rather, that new ideas or lessons learned will emerge during that process that impact subsequent actions or would do so were time or resource constraints not an impediment. The iterative process is recursive rather than linear, and often involves going back to review and revise earlier thinking in order to move forward.

Articulation of limitations: Engineering design often requires years of iterative research, development, and testing, with access to, and consumption of, abundant resources. In the absence of adequate time or human and material resources, students should identify and explain the resultant impact on their design and discuss what could be done additionally to justify the viability of their design and ideas. The inclusion of supporting detail such as the recommendations of experts in similar contexts will enhance the validity of your articulation of limitations and the means of addressing them that you propose and justify.

Engineering Design Process Portfolio Rubric

About the Rubric

The Engineering Design Process Portfolio Rubric identifies six levels of performance based on the following generic scoring scale:

- **5 Exemplary**: Demonstrates thorough and penetrating understanding of key concepts; exhibits copious evidence of attainment of skills
- **4 Advanced**: Demonstrates considerable understanding; exhibits considerable (substantial) evidence of attainment of skills
- **3 Proficient**: Demonstrates general /adequate understanding of key concepts; exhibits adequate evidence of attainment of skills
- **2 Developing**: Demonstrates a partial understanding of key concepts; exhibits some evidence of attainment of skills
- **1 Novice**: Demonstrates a lack of/little understanding of key concepts; exhibits minimal evidence of attainment of skills
- **0 No evidence (**No evidence of engagement, pre-engagement**)**: Demonstrates no understanding of key concepts; exhibits no evidence of attainment of skills

Specific descriptors are provided to define these levels of performance for the various elements of each of six components or steps in the design process:

- Identifying, articulating, and justifying a problem
- Analysis of current and past solution attempts
- Generating an original solution
- Constructing a testable prototype or process
- Analyzing test data
- Reflecting and formulating recommendations
- Documenting and presenting the project

Individual elements (score scales and descriptors) can be used by the student as a formative self-assessment tool or by the teacher for the purpose of interim assessment. For purposes of summative assessment, the scores for each required element of the completed portfolio can be aggregated and converted to an overall score, using a formula established by the individual teacher, program, or institution. It is recommended that students conduct a self-assessment using the full battery of score scales before submitting the final portfolio/project to their teacher.

Engineering Design Process Portfolio Rubric

Component I: Identifying, Articulating, and Justifying a Problem

Element A: Identification and definition of the problem
Element B: *Justification of the problem*
Element C: *Documentation and analysis of past and current solution attempts*
Element D: *Identification, definition, and justification of solution design goals, parameters and constraints*

Component II: Generating an Original Solution

Element E: *Demonstration of design process thinking and analysis*
Element F: *Application of mathematics, science, and engineering principles*
Element G: *Demonstration of design viability*

Component III: Constructing a Testable Prototype or Process

Element H: *Demonstration of sufficiency of prototype design process*
Element I: *Demonstration of sufficiency of final prototype iteration*
Element J: *Demonstration of sufficiency of testing*

Component IV: Analyzing Test Data

Element K: *Analysis of the design based on testing*
Element L: *Documentation of end user and stakeholder evaluation (external evaluation)*

Component V: Reflecting and Formulating Recommendations

Element M: *Reflection on the project design*
Element N: Presentation of designer's recommendations

Component VI: Documenting and Presenting the Project

Element O: Presentation of the project portfolio
Element P: Writing like an Engineer

Component I: Identifying, Articulating, and Justifying a Problem

Element A: Identification and definition of the problem

5 The problem is clearly and objectively identified and defined with considerable depth and consistent precision of detail as elaboration

4 The problem is clearly and objectively identified and defined with some depth and precision of detail as elaboration

3 The problem is clearly and objectively identified and defined with adequate depth; some detail may be imprecise (general) or unelaborated

2 The problem is identified and defined in a manner that is sometimes/somewhat unclear and/or may manifest some subjectivity

1 The identification and/or definition of the problem is unclear and/or is clearly subjective

0 The identification and/or definition of the problem is missing OR cannot be inferred from information included

Element B. Justification of the problem

5 The justification addresses all angles or aspects of the problem (producer, distributor, consumer, end-user) and is based on comprehensive, timely, and consistently credible sources; it offers consistently objective detail from which goals and measurable design parameters can be determined

4 The justification addresses many but not all angles or aspects of the problem and is based on a variety of timely and generally credible sources; it offers objective detail from which goals and measurable design parameters can be determined

3 The justification addresses several angles or aspects of the problem and is based on several generally timely and credible sources; although not all information may be objective, it offers enough objective detail from which goals and design parameters can be determined

2 The justification addresses only one angle or aspect of the problem and may be based on insufficient sources and/or some sources that are outdated or of dubious credibility; at least one objective goal or design parameter is derived from sources presented

1 A justification, if intended, is not clearly linked to any angle or aspect of the problem and/or is based on sources that are overly general, outdated, and/or of dubious credibility; general design parameters may be presented but the information provided does not allow for the determination of objective or measurable goals.

0 A justification of the problem is missing, cannot be inferred from information included as evidence, OR is essentially the opinion of the researcher

Element C. Documentation and analysis of past and current solution attempts

5 Documentation of past and current attempts to solve the problem is drawn from a wide array of clearly identified and consistently credible sources; the analysis of past and current attempts to solve the problem—including both strengths and shortcomings—is consistently clear, detailed, and supported by data (measurable)

4 Documentation of past and current attempts to solve the problem is drawn from a variety of clearly identified and generally credible sources; the analysis of past and current attempts to solve the problem—including both strengths and shortcomings—is clear and is generally detailed and supported by data

3 Documentation of past and current attempts to solve the problem is drawn from several—but not necessarily varied—clearly identified and consistently credible sources; the analysis of past and current attempts to solve the problem—including both strengths and shortcomings—is generally clear and contains some detail and supporting data

2 Documentation of past and current attempts to solve the problem is drawn from a limited number of sources, some of which may not be clearly identified and/or credible; the analysis of past and current attempts to solve the problem—including strengths and/or shortcomings—is overly general and contains little detail and/or supporting data

1 Documentation of past and/or current attempts to solve the problem is drawn from only one or two sources that may not be clearly identified and/or credible; the analysis of past and current attempts to solve the problem—including strengths and/or shortcomings—is vague and is missing any relevant details and/or supporting data

0 Documentation of past and/or current attempts to solve the problem is missing or minimal (a single source that is not clearly identified and/or credible) OR cannot be inferred from information intended as analysis of past and/or current attempts to solve the problem

Element D. Identification, definition, and justification of solution design goals, parameters and constraints

5 Design goals, parameters, and constraints are all clearly listed, formatted, prioritized and detailed; these design goals, parameters, and constraints presented are consistently objective, measurable, and would with certainty lead to a tangible and viable solution to the problem identified; there is evidence that goals, parameters, and constraints have been validated by multiple qualified representatives of end-users, stakeholders, and field experts

4 Design goals, parameters, and constraints are listed, formatted, prioritized and are generally clear and detailed; these design goals, parameters, and constraints presented are nearly always objective and measurable, and would be likely to lead to a tangible and viable solution to the problem identified; there is evidence that goals, parameters, and constraints have been validated by one or two qualified representative end-users, stakeholders and field experts

3 Design goals, parameters, and constraints are listed, formatted, prioritized and are generally clear and somewhat detailed; these design goals, parameters, and constraints presented are generally objective and measurable, and have the potential to lead to a tangible and viable solution to the problem identified; there is evidence that goals, parameters, and constraints have been validated by at least one qualified representative end-user, stakeholder and field expert OR two representatives from two of these groups

2 Design goals, parameters, and constraints are listed, formatted, and prioritized, but some/all of these may be incomplete and/or lack specificity; these design goals, parameters, and constraints may be only sometimes objective and/or measurable, and it is not clear that they will lead to a tangible and viable solution to the problem identified; there is evidence that the goals, parameters, and constraints have only been validated by one or two qualified representatives from among end-users, stakeholders, and/or field experts

1 An attempt is made to list, format, and prioritize design goals, parameters, and constraints, but these may be partial and/or overly general, making them insufficiently measurable to support a viable solution to the problem identified; there is no evidence that the goals, parameters, and/or constraints have been validated by a representative end-user, stakeholder, or field expert

0 Design goals, parameters, and/or constraints are either not presented or are too vague to be used to outline the measurable attributes of a possible design solution to the problem identified

Component II: Generating an Original Solution

Element E: Demonstration of design process thinking and analysis

5 The process for generating and verifying possible design solutions was comprehensive, deeply iterative, and consistently defensible, virtually ensuring a viable and well-justified design directly and objectively based upon the design parameters; the plan of action has considerable merit and easily supports repetition and testing for effectiveness by others

4 The process for generating and verifying possible design solutions was thorough, iterative and defensible, making a viable design very likely; the design solution chosen was justified and met design parameters; the plan of action supports repetition and testing for effectiveness by others

3 The process for generating and verifying possible design solutions was adequate and generally iterative and defensible, making a viable design possible; the choice of design solution was explained with reference to design parameters; the plan of action may not clearly facilitate [support] repetition and testing for effectiveness by others

2 The process for generating a possible design solution was partial or overly general and only somewhat iterative and/or defensible, raising issues with the viability of the design solution chosen; that solution was not sufficiently explained with reference to design parameters; there is insufficient detail to allow for testing for replication of results

1 The process for generating a possible design solution was incomplete and only minimally iterative and/or defensible; any attempted explanation for the design solution chosen lacked support related to design parameters and cannot be tested

0 There is no evidence an attempt to arrive at a design solution through an iterative process based on design parameters

Element F: Application of mathematics, science, and engineering principles

5 Technical understanding of the problem and justification of the merit of the design as a possible solution to that problem are substantiated with considerable references to math, science, and engineering principles related to the design constraints, project goals, and design criteria; All functional claims of the proposed solution are supported with sound and detailed content evidence; the review and verification [validation] of that evidence by two or more experts (qualified consultants and/or project mentors) is provided

4 Technical understanding of the problem and justification of the merit of the design as a possible solution to that problem are substantiated with references to math, science, and engineering principles related to the design constraints, project goals, and design criteria; most, if not all, functional claims of the proposed solution are supported with sound and generally detailed content evidence; the review and verification [validation] of that evidence by one expert (qualified consultant and/or project mentor) is provided

3 Technical understanding of the problem and justification of the merit of the design as a possible solution to that problem are somewhat supported with references to math, science, and/or engineering principles related to the design constraints, project goals, and design criteria; most of the functional claims of the proposed solution are supported with sound and detailed content evidence

2 Technical understanding of the problem and/or justification of the merit of the design as a possible solution to that problem are minimally supported with references to math, science, and/or engineering principles related to the design constraints, project goals, and/or design criteria; only some of the functional claims of the proposed solution are supported with sound and/or detailed content evidence

1 Technical understanding of the problem and/or justification of the merit of the design as a possible solution to that problem are minimally supported with references to math, science, and/or engineering principles related to the design constraints, project goals, and/or design criteria; few of the functional claims of the proposed solution are supported with sound and/or detailed content evidence

0 Neither technical understanding of the problem nor justification of the merit of the design as a possible solution to that problem are even minimally supported with references to math, science, and/or engineering principles related to the design constraints, project goals, and/or design criteria; none of the functional claims of the proposed solution are supported with appropriate content evidence

Element G: Demonstration of design viability

5 There is substantial credible evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner; detailed documentation of review of a production and marketing plan by two or more qualified professionals is included

4 There is sufficient credible evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner; documentation of review of a production and marketing plan by two or more qualified professionals is included and is detailed for at least one

3 There is some credible evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner, although some information intended to substantiate particular ideas may lack detail; there is detailed documentation of review of a production and marketing plan by one qualified professional or partial/overly general documentation of review by two or more qualified professionals

2 There is some evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner, although this evidence may be partial (partially complete and/or only somewhat credible); documentation of review of a production and marketing plan by at least one qualified professional is included but is missing or incomplete for any others consulted

1 There is little (minimal) evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner, and this evidence may be overly general, inconsistent or unclear; although there is evidence that some form of review of a production and marketing plan by a qualified professional took place, there is little/no useful documentation of that review

0 There is no evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner; some form of review of a production and marketing plan by a qualified professional took place, there is no useful documentation of that review

Component III: Constructing a Testable Prototype or Process

Element H: Demonstration of sufficiency of prototype design process

5 The prototype design process involved substantial purposeful and test-driven iteration; it was supported by clear and thorough explanation of the choices made as the design evolved and of how the final iteration could be improved for testing purposes; the prototype design process facilitated testing by suitable means (e.g., physical and/or mathematical modeling) to the fullest extent realistically possible so that the solution design addresses all of what should be considered primary goals

4 The prototype design process involved substantial and mostly purposeful and test-driven iteration; it was supported by clear and well-developed explanation of the choices made as the design evolved and of how the final iteration could be improved for testing purposes; the prototype design process often facilitated testing by suitable means to the extent realistically possible so that the solution design addresses all but one of what should be considered the primary goals

3 The prototype design process involved adequate and generally purposeful and test-driven iteration; it was supported by clear and adequately developed explanation of the choices made as the design evolved and of how the final iteration could be improved for testing purposes; the prototype design process generally facilitated testing by suitable means to the extent realistically possible so that the solution design addresses many of what should be considered the primary goals

2 The prototype design process involved some purposeful and test-driven iteration; it was supported by somewhat clear and partially developed explanation of the choices made as the design evolved and of how the final iteration could be improved for testing purposes; the prototype design process only sometimes/somewhat facilitated testing by suitable means to the extent realistically possible so that the solution design may only partially address what should be considered primary goals

1 The prototype design process involved some iteration, but the purposefulness of iterations was sometimes unclear and/or not clearly test-driven; the explanation of the choices made as the design evolved and/or how the final iteration could be improved for testing purposes was partial or

overly general; the prototype design process rarely facilitated testing by suitable means to the extent realistically possible so that the design solution fails to address most of what should be considered the primary goals

0 The prototype design process involved minimal iteration (not clearly test-driven) or was a first design attempt; the explanation of the choices made as the design evolved and/or how the final iteration could be improved for testing purposes was vague or missing altogether; the prototype design process did not facilitate testing by suitable means to the extent realistically possible and may not address any of what should be considered the primary goals

*Element I: Demonstration of sufficiency of final prototype **iteration***

5 The final prototype iteration is clearly and fully explained and is constructed with enough detail to assure that some level of objective data demonstrating the success with which each stated goal has been met can be determined through testing, mathematical modeling, or detailed expert reviews; all attributes of the unique solution that could be tested or modeled mathematically are addressed in the prototyping design, and a well-supported justification is provided for those that cannot be tested or modeled mathematically and thus require expert review

4 The final prototype iteration is clearly and substantially explained and is constructed with enough detail to assure that some level of objective data demonstrating the success with which each stated goal has been met can be determined through testing, mathematical modeling, or detailed expert reviews; nearly all attributes of the unique solution that could be tested or modeled mathematically are addressed in the prototyping design, and a justification is provided for nearly all of those that cannot be tested or modeled mathematically and thus require expert review

3 The final prototype iteration is adequately explained and is constructed with enough detail to assure that some level of objective data demonstrating the success with which most stated goals have been met can be determined through testing, mathematical modeling, or detailed expert reviews; at least some attributes of the unique solution that could be tested or modeled mathematically are addressed in the prototyping design, and a justification is provided for at least some of those that cannot be tested or modeled mathematically and thus require expert review

2 The explanation of the final prototype iteration is partial/overly general and is constructed with minimal detail to convey that the success with which stated goals have been met can be determined through testing, mathematical modeling, or detailed expert reviews; few attributes of the unique solution that could be tested or modeled mathematically are addressed in the prototyping design, and there may be minimal justification for one or more of those that cannot be tested or modeled mathematically and thus require expert review

1 The explanation of the final prototype iteration is vague and lacks detail to convey that the success with which stated goals have been met can be determined through testing, mathematical modeling, or detailed expert reviews; justification for any that cannot be tested or modeled mathematically and thus require expert review may be missing or unclear

0 An explanation of the final prototype iteration is missing altogether or is attempted but fails to address the use of testing, mathematical modeling, and/or detailed expert review to determine the degree of success with which stated goals have been met can be determined

Element J: Demonstration of sufficiency of testing

5 The testing procedure targeted each of the stated design goals and provided a consistently clear and logical explanation of how it would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is fully supported with numerous appropriate pictures, graphs, and/or charts and there is substantial documentation that testing data was reviewed by a mentor in the science field; a consistently detailed plan for improvement of each portion of the testing based upon lessons learned during the testing process was formulated and attempted wherever possible

4 The testing procedure targeted each of the stated design goals and provided (with only minor flaws or omissions) a clear and logical explanation of how it would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is well supported with ample pictures, graphs, and/or charts and there is sufficient documentation that testing data was reviewed by a mentor in the science field; a generally detailed plan for improvement of each portion of the testing based upon lessons learned during the testing process was formulated and attempted wherever possible

3 The testing procedure targeted each of the stated design goals and provided a generally clear and logical explanation of how it would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is supported with adequate pictures, graphs, and/or charts and there is sufficient documentation that testing data was reviewed by a mentor in the science field; a plan for improvement of each portion of the testing based upon lessons learned during the testing process was formulated but was only partially attempted

2 The testing procedure targeted most but not all of the stated design goals and provided a generally clear and logical explanation of how they would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is only partially supported with pictures, graphs, and/or charts and there is insufficient documentation that testing data was reviewed by a mentor in the science field; a plan for improvement of each portion of the testing based upon lessons learned during the testing process may have been formulated, at least in part, but was minimally attempted

1 The testing procedure targeted only some of the stated design goals and provided an overly general or sometimes illogical explanation of how they would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is minimally supported with pictures, graphs, and/or charts and there is little or no documentation that testing data was reviewed by a mentor in the science field; a plan for improvement of each portion of the testing based upon lessons learned during the testing process may have been formulated, at least in part, but was not attempted

0 The testing procedure targeted few if any of the stated design goals and provided little or no explanation of how they would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is not supported with any appropriate pictures, graphs, and/or charts and there is little or no documentation that testing data was reviewed by a mentor in the science field; no plan for improvement of each portion of the testing based upon lessons learned during the testing process was formulated

Component IV: Analyzing Test Data

Element K: Analysis of the design based on testing

5 The analysis of the effectiveness with which the design met stated goals includes a consistently detailed explanation [and summary] of the data from each portion of the testing procedure and from expert reviews, generously supported by pictures, graphs, charts and other visuals; the analysis is enhanced by comprehensive reflection on the quality of test data and their interpretation and a substantive and suitable plan of action as a consequence of that reflection; the analysis includes an overall summary of the implications of all data for proceeding with the design and solving the problem

4 The analysis of the effectiveness with which the design met stated goals includes a generally detailed explanation [and summary] of the data from each portion of the testing procedure and from expert reviews, generally supported by pictures, graphs, charts and other visuals; the analysis is enhanced by considerable reflection on the quality of test data and their interpretation and a suitable plan of action as a consequence of that reflection; the analysis includes an overall summary of the implications of all data for proceeding with the design and solving the problem

3 The analysis of the effectiveness with which the design met stated goals includes an adequately detailed explanation [and summary] of the data from each portion of the testing procedure (OR a well-detailed explanation of most but not all portions) and from expert review(s), adequately supported by pictures, graphs, charts and other visuals; the analysis is enhanced by some reflection on the quality of test data and their interpretation and a generally suitable but somewhat general plan of action as a consequence of that reflection; the analysis includes an overall summary of the implications of most, if not all, data for proceeding with the design and solving the problem

2 The analysis of the effectiveness with which the design met stated goals includes a partial or somewhat general explanation [and summary] of the data from most portions of the testing procedure (OR a well-detailed explanation of only a few portions) and from expert review(s), only somewhat supported by pictures, graphs, charts and other visuals; the analysis includes partial/overly general reflection on the quality of test data and their interpretation and an only somewhat suitable and/or overly general plan of action as a consequence of that reflection; the analysis includes a summary of the implications of at least some data for proceeding with the design and solving the problem

1 The analysis of the effectiveness with which the design met stated goals includes an overly general explanation [and summary] of the data from at least a few portions of the testing procedure and from expert review(s), only minimally supported by pictures, graphs, charts and other visuals; the analysis includes minimal reflection on the quality of test data and their interpretation and an only somewhat suitable and/or overly general plan of action as a consequence of that reflection; the analysis includes a summary of the implications of at least some data for proceeding with the design and solving the problem

0 The analysis of the effectiveness with which the design met stated goals provides a vague or fragmentary explanation [and summary] of the data from the testing procedure and from expert review(s), and may be missing any support through pictures, graphs, charts and other visuals; the analysis may includes minimal reflection on the quality of test data and their interpretation but no plan of action as a consequence of that reflection OR a plan of action from which reflection must be inferred; the analysis may be missing a summary of the implications of any of the data for proceeding with the design and solving the problem

Element L: Documentation of end user and stakeholder evaluation (external evaluation)

5 Documentation of project evaluation by multiple, demonstrably qualified end-users, stakeholders, and field experts is consistently specific, detailed, and thorough, and is sufficient in at least one category to yield a statistically significant analysis of that evaluation data; evaluations consistently include specific questions, concerns, and opinions regarding each part of the testing procedure and data analysis

4 Documentation of project evaluation by two or more demonstrably qualified end-users, stakeholders, and field experts is specific, detailed, and thorough, although insufficient in any category to yield a statistically significant analysis of that evaluation data; evaluations include specific questions, concerns, and opinions regarding each part of the testing procedure and data analysis

3 Documentation of project evaluation by one demonstrably qualified end-user, stakeholder, and field expert is generally specific and detailed, but may not be thorough; evaluations include at least some specific questions, concerns, and opinions regarding each part of the testing procedure and data analysis

2 Documentation of project evaluation by a demonstrably qualified representative of two of three possible sources (end-users, stakeholders, and field experts) is only somewhat specific and/or detailed; documentation of evaluation from a third source may be included but is incomplete or overly general; evaluations include at least some specific questions, concerns, and/or opinions regarding each part of the testing procedure and data analysis

1 Documentation of project evaluation by a demonstrably qualified representative of one of three possible sources (end-users, stakeholders, and field experts) but is sparse, with few specifics/details; documentation of additional evaluation(s) may be included but is incomplete, overly general, or missing evidence of qualification as a source; the evaluation includes a few specific questions, concerns, and/or opinions regarding each part of the testing procedure and/or data analysis

0 Documentation of project evaluation by a representative of one of three possible sources (end-users, stakeholders, and field experts) is non-existent OR may be included but may be minimal (only one or two questions, concerns, or opinions regarding a part of the testing procedure or data analysis) and/or missing evidence of qualification as a source

Component V: Reflecting and Formulating Recommendations

Element M: Reflection on the project design

5 The project designer provides a consistently clear, insightful, and comprehensive reflection on, and value judgment of, each major step in the project; the reflection includes a substantive summary of lessons learned that would be clearly useful to others attempting the same or similar project

4 The project designer provides a clear, insightful and well-developed reflection on, and value judgment of, each major step in the project; the reflection includes a summary of lessons learned that would be clearly useful to others attempting the same or similar project

3 The project designer provides a generally clear and insightful, adequately-developed reflection on, and value judgment of, major steps in the project, although one or two steps may be addressed in a more cursory manner; the reflection includes a summary of lessons learned, at least most of which would be useful to others attempting the same or similar project

2 The project designer provides a generally clear, at least somewhat insightful, and partially developed reflection on, and value judgment of, most if not all of the major steps in the project; the reflection includes some lessons learned which would be useful to others attempting the same or similar project

1 The project designer provides a reflection on, and value judgment of, at least some of the major steps in the project, although the reflection may be partial, overly-general and/or superficial; the reflection includes a few lessons learned of which at least one would be useful to others attempting the same or similar project

0 The project designer attempts a reflection on, and value judgment of, at least one or two of the major steps in the project, although the reflection may be minimal, unclear, and/or extremely superficial; any lessons learned are unclear and/or of no likely use to others attempting the same or similar project; OR there is no evidence of a reflection and/or lessons learned

Element N: Presentation of designer's recommendations

5 The project designer includes consistently detailed and salient recommendations regarding the conduct of the same or similar project in the future; recommendations include caveats as warranted and specific ways the project could be improved with consistently detailed plans for the implementation of those improvements

4 The project designer includes generally detailed and salient recommendations regarding the conduct of the same or similar project in the future; recommendations include caveats as warranted and specific ways the project could be improved with generally detailed plans for the implementation of those improvements

3 The project designer includes a few detailed and salient recommendations regarding the conduct of the same or similar project in the future; recommendations include some specific ways the project could be improved along with what may be only minimally detailed plans for the implementation of those improvements and may also include one or two caveats for others

2 The project designer includes recommendations regarding the conduct of the same or similar project in the future; recommendations may include some specific ways the project could be improved but plans for the implementation of those improvements may be missing OR the recommendations (with or without plans) may be partial and/or overly general.

1 The project designer includes one or two overly general and/or questionably relevant recommendations regarding the conduct of the same or similar project in the future; any plans for implementation included are vague/unclear or minimally related to the recommendations provided

0 The project designer includes one or two recommendations (with or without plans) that bear little/no relation to the conduct of the same or similar project in the future OR fails to offer any recommendations or plans regarding the conduct of the same or similar project in the future

Component VI: Documenting and Presenting the Project

Element O: Presentation of the project portfolio

5 The portfolio provides consistently clear, detailed, and extensive documentation of the design process and project that would with certainty facilitate subsequent replication and refinement by the designer(s) and/or others; attention to audience and purpose was abundantly evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials

4 The portfolio provides clear, generally detailed and thorough documentation of the design process and project that would be likely to facilitate subsequent replication and refinement by the designer(s) and/or others; attention to audience and purpose was evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials

3 The portfolio provides generally clear and thorough documentation of the design process and project that would be likely to facilitate subsequent replication and refinement by the designer(s) and/or others, although there may be some minor omissions or inconsistencies; attention to audience and purpose was generally—but not always--evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials

2 The portfolio provides partial or sometimes overly general documentation of the design process and project that would be likely to facilitate subsequent replication and refinement by the designer(s) and/or others; attention to audience and purpose was only sometimes/somewhat evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials

1 The portfolio provides minimal documentation of the design process and project that would be likely to facilitate subsequent replication and refinement by the designer(s) and/or others; attention to audience and purpose was rarely evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials

0 The portfolio attempts to document the design process and project but little/none of that information supports subsequent replication and refinement by the designer(s) and/or others; little/no attention to audience and purpose was evident in the choice of mode(s) of presentation, professionalism of style and tone, or the variety, quality, and suitability of any supporting materials included

Element P: Writing like an Engineer

5 Abundant evidence of the ability to write consistently clear and well organized texts that are developed to the fullest degree suitable for the audience and purposes intended (to explain, question, persuade, etc.); texts consistently demonstrate the ability to adjust language, style and tone to address the needs and interests of a variety of audiences (e.g., expert, informed, general/lay audience) and to use a wide variety of forms which are commonplace among STEM disciplines (e.g., notes, descriptive/narrative accounts, research reports); where required by convention, appropriate documentation in standardized form (e.g., APA) is consistently evident.

4 Evidence of the ability to write clear and well organized texts that are generally well-developed for the audience and purposes intended (to explain, question, persuade, etc.); texts generally demonstrate the ability to adjust language, style and tone to address the needs and interests of a variety of audiences (e.g., expert, informed, general/lay audience) with minor exceptions and demonstrate the ability to use a variety of forms which are commonplace among STEM disciplines (e.g., notes, descriptive/narrative accounts, research reports); where required by convention, appropriate documentation in standardized form (e.g., APA) is generally evident.

3 Adequate evidence of the ability to write usually clear and generally organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate the ability to adjust language, style and tone to address the needs and interests of several different audiences (e.g., expert, informed, general/lay audience) but may be unsuccessful at doing so on occasion; texts demonstrate the ability to use a several different forms which are commonplace among STEM disciplines; where required by convention, appropriate documentation in standardized form (e.g., APA) is sometimes evident, although attempts at documentation may reveal minor errors;

2 Only some evidence of the ability to write clear and organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate some ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience) but adjustments are not evident—although warranted—in a number of instances; texts demonstrate the ability to use at least two different forms which are commonplace among STEM disciplines; where required by convention, appropriate documentation in standardized form (e.g., APA) is frequently missing or incorrect.

1 Little evidence of the ability to write clear and organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate little ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience) but many adjustments are not evident—although warranted; texts demonstrate the attempt to use at least two different forms which are commonplace among STEM disciplines; appropriate documentation in standardized form (e.g., APA) is usually missing or incorrect.

0 Virtually no evidence of the ability to write even somewhat clear and organized texts that are developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate virtually no ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience); there may be evidence of an attempt to use at least two different forms which are commonplace among STEM disciplines but these are not correctly differentiated; there is virtually no evidence of any attempt to provide documentation in standardized form where needed.