

Table 2. Report grading rubric

ABET Outcome	Ability	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
A1	Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics: Identify and formulate a problem in the medical or bioscience community; evaluate its relative and absolute importance; cast need as engineering challenge; demonstrate device or process that addresses the problem.	Medical or scientific need is clearly explained; current costs (health, economic, social, etc.) are used to justify project; problem is cast as engineering challenge; device or process is shown to be an effective solution to the need.	Medical or scientific need is stated; current costs (health, economic, social, etc.) are mentioned but may not be fully explained; problem is cast as engineering challenge; device or process is shown to meet project goals but may not be related to original need.	Medical or scientific need is stated; some current costs are mentioned; engineering design may be inappropriate for challenge; device or process is implemented but is only partially effective or is not related to project goals.	Need is not clear, problem is not addressable by engineering solutions, and/or the project does not satisfy the stated needs.	
A2	Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors: Apply design plans developed in BIOEN 401 while considering multiple design options and realistic constraints (such as cultural, social, economic, and engineering standards); modify and improve the design based on experimental results to meet specified needs (iterate on design); consider risks and trade-offs during design process	Report describes how the design incorporated multiple realistic constraints and was adapted to meet desired outcome, based on acquired results. Report discusses engineering standards relevant to project and when applicable, describes how the relevant engineering standards were incorporated into design decisions. Report thoroughly analyzes public health, safety, and welfare, global, cultural, social, environmental and economic factors and includes the relevant factors in design specifications. Describes multiple options, test results, and choice of final option. Report thoroughly describes risks considered and trade-offs made during design process.	Report describes how the design incorporated multiple realistic constraints, including appropriate engineering standards, and how the design was adapted to meet the desired outcome, based on acquired results. Report satisfactorily analyzes public health, safety, and welfare, global, cultural, social, environmental and economic factors and includes the relevant factors in design specifications. Describes at least one option, test results, and choice of final option. Risks and trade-offs were made but could be more thoroughly discussed.	Report describes how the design incorporated some realistic constraints but other relevant constraints were not considered. Report analyzes public health, safety, and welfare, global, cultural, social, environmental and economic factors and includes some relevant factors in design specifications, but analysis and incorporation of relevant factors may be incomplete. Report describes how the design was adapted to meet desired outcome. One option is considered but not tested. Obvious risks involved in the design may not be described.	Report does not describe the consideration of realistic constraints during the design process or risks and trade-offs involved in the design process. Report does not discuss any consideration of design modifications. Report does not identify relevant engineering standards. Report does not include analysis of public health, safety, and welfare, global, cultural, social, environmental and economic factors related to the project, and does not include the relevant factors in design specifications.	

A3	<p>Communicate effectively: Prepare detailed written report that addresses engineering design, economic, and societal issues as shown in report outline.</p>	<p>Written report is well-written and concise, virtually error-free, and logically presents project. Report is well-organized and easy to understand, and contains high quality data/graphics.</p>	<p>Report is overall logically presented, well-organized, contains high quality data & graphics, with few minor grammatical or rhetorical errors. Everything is understandable, but may require extra time and effort to read because text or figures are not concise or lack summarizing text.</p>	<p>Report is acceptably written but contains grammatical, rhetorical and/or organizational errors; project is not well explained and not fully discussed. Report may be hard to follow.</p>	<p>Does not present project clearly, is poorly organized and/or contains major grammatical and/or rhetorical errors. One or more key points of the report cannot be understood.</p>	
A4	<p>Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts: Display knowledge of ethical and professional responsibilities surrounding the design, such as regulatory matters including standards, and environmental, social, legal, ethical, and public health, safety, and welfare considerations. Describe impact of solution in global, economic, environmental, and societal contexts.</p>	<p>Report thoroughly identifies ethical and professional responsibilities surrounding the design, such as regulatory matters including standards, and environmental, social, legal, ethical, and public health, safety, and welfare considerations. Analysis of these factors was used to make informed judgements during the design process (i.e. generation of design specifications). Thoughtfully and completely describes impact of engineering solution in global, economic, environmental, and societal contexts.</p>	<p>Report identifies a satisfactory number of ethical and professional responsibilities surrounding the design, such as regulatory matters including standards, and environmental, social, legal, ethical, and public health, safety, and welfare considerations. Analysis of these factors was used to make informed judgements during the design process (i.e. generation of design specifications). Describes impact of engineering solution in each of the following contexts: global, economic, environmental, and societal.</p>	<p>Report identifies only a few of ethical and professional responsibilities surrounding the design, such as regulatory matters including standards, and environmental, social, legal, ethical, and public health, safety, and welfare considerations. Report is unclear as to how analysis of these factors was used to make informed judgements during the design process (i.e. generation of design specifications). Incomplete description of the impact of engineering solution in global, economic, environmental, and societal contexts.</p>	<p>Report identifies only a few of the most obvious ethical and professional responsibilities surrounding the design, such as regulatory matters including standards, and environmental, social, legal, ethical, and public health, safety, and welfare considerations. Report is unclear as to how analysis of these factors was used to make informed judgements during the design process (i.e. generation of design specifications). Description of the impact of engineering solution in global, economic, environmental, and societal contexts is cursory or missing completely.</p>	
A6	<p>Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions: Utilize BioE skills to test experimental hypotheses or prototypes from design plans developed in BIOEN 401; correctly analyze results; provide compilation and interpretation of results in written report.</p>	<p>Analysis is complete, correct and conclusions are consistent with results. Appropriate analytical methods are selected and correctly implemented. Report logically explains motivation for well-designed experiments, and how the results address hypotheses and designs.</p>	<p>Analysis is complete but contains 1 or 2 minor errors. Analytical methods are appropriate and correctly implemented. Logically explains motivation for experiments, and how the results address hypotheses and designs, but with some logical flaws.</p>	<p>Analysis is overall satisfactory, but contains 1 or more conceptual and/or procedural errors. Experiments are appropriate to the problem, but may not be correctly designed, implemented, or interpreted.</p>	<p>Analysis contains major conceptual and/or procedural errors. Experiments are inappropriately selected and/or not designed and implemented correctly. Conclusions not supported by appropriate experimentation or interpretation of data.</p>	

BIOEN 402 SYLLABUS FOR 2018-19

A7	Acquire and apply new knowledge as needed, using appropriate learning strategies: Show/describe the continuous progress in the field prior to and during Capstone project via literature search and analysis.	Current and seminal literature is discussed and interpreted in relation to the significance and novelty of the project; key advances relevant to the project are identified. Proper referencing shows that the literature was thoroughly searched and analyzed.	The number and quality of citations indicates a thorough literature search. Literature is discussed in relation to the project but interpretation may not be sufficiently logical or may not completely address significance and novelty of project. Sources are cited throughout paper where needed.	The current literature is mentioned/listed, indicating an adequate literature search but key literature is missing. Information sources are cited throughout paper where required.	Number and brevity of citations indicates only a minimal literature search. Statements are made without citing information source.	
Apply Math (Program Criterion W)	Apply mathematics (including statistics) and engineering to solve bio/biomedical engineering problems. Preparation on this topic via Capstone should emphasize statistical analysis when appropriate to support conclusions.	Masters appropriate mathematical techniques during quantitative analysis and planning of work; addresses each hypothesis posed in experimental design; performs statistical analysis using appropriate methods and describes why the methods are appropriate for the problem, includes adequate sample sizes and thorough control experiments.	Correctly applies undergraduate-level engineering mathematics in analysis and planning of work; addresses hypotheses posed in experimental design; performs statistical analysis to assess statistical significance of conclusions, with appropriate methods, adequate sample sizes and some control experiments.	Applies basic mathematics to theoretical analysis; performs statistical analysis to assess statistical significance of conclusions, but may use inappropriate methods, analysis may be insufficient or has errors	Incorrectly applies engineering mathematics; does not quantitatively address hypotheses posed in experimental design.	