### BME Design evaluation and grading criteria for a score of 4 out of 4 on reports and notebooks

<table>
<thead>
<tr>
<th>Outcomes (1-7) and Performance Indicators</th>
<th>Criteria Required for 4/4</th>
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<tr>
<td><strong>1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</strong></td>
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| Identified and formulated biomedical problems to be solved by: | • Used appropriate empirical and theoretical approaches to inform design  
• No filler/irrelevant material  

Applied appropriate engineering principles to solve... | • Correctly applied knowledge from engineering areas such as statics, dynamics, circuits, material science, etc.  

Applied appropriate biology and physiology to solve... | • Clearly communicated bio/physio  
• Problem description appropriately motivated by bio/physio  

Applied appropriate chemistry to solve... | • Chemical structure/functional relationships are described  

Applied appropriate math (e.g. differential equations) to solve... | • Solved engineering problems with appropriate math and differential equations  

Applied statistics to solve... | • Established and tested hypotheses  
• Used appropriate approaches for data analysis including sample sizes and statistical methods |
| **2. an ability to 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** | |
| Quantified the needs of the biomedical problem | • PDS quantitative and complete  

Identified multiple and realistic design constraints | • Several criteria evaluated-design matrix  
• Criteria addressed appropriate public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors  

Developed and evaluated multiple viable design alternatives | • Design alternatives provided evidence of multiple viable approaches  
• Design matrix scores well justified  

Modeled and realized the recommended solution that met or exceeded the specifications | • Final design met or exceeded client-specified and design criteria and worked as intended  
• Design problems identified and solutions logically presented  

Considered appropriate codes and standards | • Cited ISO, ASTM, FDA, etc.  
• Described operating environment, used SI units etc. |
| **3. an ability to communicate effectively with a range of audiences** | |
| Communicated in an understandable technical style to a qualified yet unfamiliar audience | • Technical writing style (non-conversational)  
• Details presented such that work is repeatable  

Demonstrated effective writing | • Virtually no errors in spelling or grammar  

Effectively organized a written document | • Layout enhances readability  
• Proper reference and citation formatting  

Demonstrated effective graphical presentation | • Effectively used graphics to illustrate key points including meaningful figure caption  
• Appropriate data presentation (e.g., labeled axes, units, sig figs.) |
| **4. an ability to 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** | |
| Conducted work in an ethical and professional manner | • No research ethics violations  
• Design concepts credited appropriately  
• Text references and figures cited appropriately  

Considered the broader impact of the biomedical problem and solution | • Researched the overall global impact (size/demographic) of the problem and solution  
• Identified beyond the need of the client when appropriate and is in context  
• Past, current and/or future ethical considerations clearly identified and addressed including the impact in global, economic, environmental, and societal contexts |
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

| Demonstrated a positive team environment | • Positive peer evaluations  
• Clustered “bonus” scores or consistent ranking  
• No non-contributors |
| Demonstrated leadership with individuals serving well-defined roles | • Identifiable individual contributions in team output  
• Leadership mentioned  
• Goals and tasks executed as planned |

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

| Developed experimental protocols to assess criteria and evaluate function | • Experiments designed to assess all relevant PDS criteria |
| Conducted experiments methodically | • Experimental approach, hypotheses and protocols led to design improvements or new approaches |
| Analyzed the experimental results | • Sources of error identified and methods to reduce error discussed |
| Drew conclusions based on experimental results | • Clear conclusions stated that follow experimental data |

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

| Cited sources of multiple types | • Several references (typically 20+) of multiple types (articles, books, websites, patents, personal communications, etc.)  
• Reference material enhanced the paper/presentation  
• Reference material in context when cited - uses multiple references for key points. |
| Demonstrated resourcefulness | • Employed the appropriate tools especially those available e.g. CAD (CAE software), COE Shop, BME Teaching Labs, modeling, etc.  
• Sought out additional tools learned new skills (as documented in peer/self eval). |