

3a. An ability to apply knowledge of mathematics, science, and engineering**a1) Apply and perform the correct mathematical analysis.**

Choose all that apply to course:

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Applies Calculus	Applies calculus appropriately without errors to solve problems	Minor errors, e.g. addition in applying calculus	Identifies that calculus is needed to solve the problem, but unable to apply	Does not recognize that calculus is needed to solve the problem	
Applies Linear Algebra	Applies linear algebra appropriately without errors to solve problems	Minor errors, eg addition in applying linear algebra	Identifies that linear algebra is needed to solve the problem, but unable to apply	Does not recognize that linear algebra is needed to solve the problem	
Applies Statistics	Applies statistics appropriately without errors	Minor errors, eg addition in applying statistics	Identifies that statistics is needed, but unable to apply	Does not recognize that statistics is needed	

a2) Prepare and solve the appropriate physical model of the problem.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Applies Physics	Applies physics appropriately without errors to solve problems	Minor errors in applying physical model to problem.	Identifies the appropriate physics principles that are needed to solve the problem, but unable to apply	Does not recognize that physics principles are needed to solve the problem	

a3) Utilize appropriate engineering principles for computer and electrical engineering.

Choose all that apply to course:

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Applies Software Principles	Applies the principle without errors.	Applies the principle with only minor errors	Identifies the appropriate principle but is unable to apply it to the problem	Does not recognize that principle applies to the problem	
Applies Hardware Principles	Applies the principle without errors.	Applies the principle with only minor errors	Identifies the appropriate principle but is unable to apply it to the problem	Does not recognize that principle applies to the problem	

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Applies Analog Circuit Principles	Applies the principle without errors.	Applies the principle with only minor errors	Identifies the appropriate principle but is unable to apply it to the problem	Does not recognize that principle applies to the problem	
Applies Digital Circuit Principles	Applies the principle without errors.	Applies the principle with only minor errors	Identifies the appropriate principle but is unable to apply it to the problem	Does not recognize that principle applies to the problem	

3b Experiments

3b. An ability to design and conduct experiments, as well as to analyze and interpret data

b1) Design and set up experiments.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Design Experiment	Experimental plan includes materials, equipment, activities, data to be collected, and clear statement of the objectives	Experimental plan is missing only one element.	Experimental plan is missing multiple elements.	Can execute an experiment with training and instructions but not plan an experiment	

b2) Conduct experiments and perform measurements.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Conduct Experiments	Able to conduct an experiment efficiently and effectively, gather data, understand hazards and use appropriate safety procedures, calibrate and operate equipment, gather and put away supplies	May be slow to complete the experiment or have to repeat a portion to get data missed the first time, or be somewhat disorganized, have to be reminded to calibrate equipment or put away supplies	One or two significant issues - for example - didn't realize they didn't collect all the data, safety issues, use of techniques that could damage the equipment	At best watches while others conduct the experiment or requires a lot repetition or instruction	

b3) Analyze data and interpret results.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Analyze Data	Correctly analyzes data sets, applying appropriate science, engineering, and statistical concepts and using appropriate formulas, visual display of data is provided, appropriate tools (eg. software) are used effectively	One or two less important elements missing or poorly executed, for example - visual representation or statistical analysis or minor computation issues like unit conversions	The data is analyzed, but statistical analysis or information about secondary concepts or formulas is missing	Unable to apply appropriate engineering or science concepts or formulas to analyze the data	

3b Experiments

<p>Intepret Results</p>	<p>Conclusions are appropriate based on data, clearly stated, with appropriate supporting visuals and possible biases are discussed. Appropriate engineering or science principles and formulas are included and explained. Assumptions and recommendations for future experiments are included. Understands the impact of statistical analysis on the conclusion</p>	<p>While the primary conclusions are solid, one or two elements are missing, poorly executed, or poorly explained</p>	<p>While the most important conclusions are included, some secondary conclusions are missing</p>	<p>There are poor links between the data analysis and conclusions.</p>	
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3c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

c1) Follow systematic and logical design procedures and define specifications to meet project requirements.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Meet Requirements	Requirements are described, converted into specifications, and fully met. The design incorporates appropriate engineering concepts. Design could be implemented.	The design meets most of the desired needs and incorporates appropriate engineering concepts. Design could be implemented with minor fixes.	The design meets the most important of the desired needs. Potentially significant technical issues with the design.	The design does not meet the needs or does not incorporate appropriate engineering concepts. Major technical issues with the design.	

c2) Adhere to realistic constraints such as environmental, social, political, ethical, health and safety, and sustainability.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Realistic Constraints	Applies at least 4 realistic constraints to the design from the following list: economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	Applies 3 constraints, other constraints might be mentioned but not actually applied	Applies 2 constraints, other constraints might be mentioned but not actually applied	Applies 1 constraint, other constraints might be mentioned but not actually applied	

c3) Consider alternative designs and choose the optimal solution.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Considers Alternatives	Alternatives are described and the reason alternatives were not selected are fully explained.	Can describe alternatives and explain some pros/cons to them.	Can identify at least one alternative and explain at least one pro or con of the alternative.	Does not identify alternatives or explain the reason alternatives were not selected.	

3d. An ability to function on multidisciplinary teams**d1) Fulfill team duties and share in the work of the team.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Contributes during meetings	Helps the team generate ideas and evaluate and select the best ones	Shares own ideas and builds on others' ideas	Shares ideas but doesn't build on others ideas	Is absent from meetings or doesn't contribute to discussions	
Contributes outside meetings	Work is thorough, comprehensive and advances the project. Checks with other team members and helps out when needed	Work is thorough, comprehensive and advances the project.	Completes all assigned tasks.	Completes most assigned tasks. Sometimes depends on others to complete the work. Contributes less than fair share.	

d2) Listen and communicate with other team members.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Engages other team members	Draws out ideas from other team members. Promotes even participation from all.	Restates and builds on other team members ideas. Sometimes prompts others for contributions	Usually listens to other team members ideas	Frequently interrupts other team members or aggressively shoots down their ideas	
Responds to conflict	Addresses conflict directly and constructively, helps the team resolve it and strengthens the team	Mediates for agreements to resolve a conflict occasionally	Helps the group get refocused on common ground and the task.	Creates conflict within the group or passively ignores the conflict	
Multidisciplinary	Values the ideas and styles that come from other disciplines. Incorporates the ideas into the project. Accomodates the differences in personal communication style	Helps the team works through the issues that arise from differences in perspective and personal style.	Over time adapts to and incorporates different perspectives and ideas from other disciplines into the project	Ignores or shoots down ideas outside engineering and technical scope. Forces others to adopt analytical, introverted communication style.	

3d Teams

d3) Research and gather information.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Ability to research a subject	Thoroughly research the subject and provide a comprehensive discussion on the topic using the information gathered from various sources.	Spend some time researching the topic and gather relevant information.	Spend a little amount of time to gather information on the topic.	Spend no time to research and gather information on the topic.	

d4) Meet deadlines and achieve project goals.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Timeliness	Completes all assigned tasks by deadline. Assists team members in meeting deadlines.	Completes all assigned tasks by deadline.	Completes most assigned tasks by deadline.	Completes some assigned tasks by deadline. Sometimes relies on other team members to complete work on time.	

d5) Cooperate on reports with a reasonable share of duties.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Share of writing duties	Work is thorough, comprehensive and advances the project. Checks with other team members and helps out when needed	Work is thorough, comprehensive and advances the project.	Completes all assigned tasks.	Completes most assigned tasks. Sometimes depends on others to complete the work. Contributes less than fair share.	

3e. An ability to identify, formulate, and solve engineering problems**e1) Develop a clear and quantifiable statement of performance requirements.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Identify engineering problems	When given information and data, or an open ended task, student is able to identify engineering problem and articulate the following: what the problem is, why it is important, and what engineering principles apply	The student identifies the most important problem, but may miss some subtleties or secondary concerns	The student may make inappropriate assumptions in identifying the problem.	The student may understand the theory and be able to identify solutions when told what the problem is, but is unable to identify the problem from the given data/information or open ended question	

e2) Develop technical specifications for the performance requirements.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Formulate engineering problems	Identifies the appropriate engineering principles that apply and the equations, formulas and tools that will lead to the solution. Clearly articulates assumptions and alternatives	Identifies the appropriate engineering principles that apply and the equations, formulas and tools that will lead to the solution	The student identifies which engineering principles apply but selects inappropriate equations or formula for the problem	The student does not identify the principles or equations and formula that apply to the problem	

3e Problems

e3) Select and implement the desirable solution and evaluate the results.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Solve engineering problems	The solution is accurate and complete and without errors. Clearly incorporates the appropriate principles, equations and formula. Assumptions are explained and justified. The solution goes through a sanity check	Minor computational errors or explanations that are hard to follow or missing	Some parts are correct, others are incorrect or missing	The student is unable to solve the problem	

3f. An understanding of professional and ethical responsibility**f1) Recognize ethical issues involved in a professional setting.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Ethical Responsibility	Has a personal value system and consistently demonstrates ethical behavior even in complex situations	Demonstrates ethical behavior in most situations.	May have small lapses in ethical behavior - tardiness, not fulfilling tasks with team	May not model ethical behavior consistently (cheating, plagiarizing)	

f2) Recognize and cope with professional and ethical issues related to safety and sustainability in engineering problems.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Professional Responsibility	Student understands the Code of Professional Engineering and how to apply it in work situtaion.	Student is aware of Code of Professional Engineering and can articulate many of the main ideas.	Student is aware of Code of Professional Engineering and can articulate a few ideas	Student is not aware of any codes of professional behavior	

3g. An ability to communicate effectively**g1) Write technical reports.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Organization	Paper is clear, logical, and well organized. Easy to follow reasoning.	Paper is generally clear and organized. A few minor points may be confusing.	Paper is difficult to follow. Many points are unclear. Organization is haphazard.	Readers are confused. Most points are unclear. Direction and focus of paper is unclear.	
Content	Technical information is at an appropriate level for the course. Key concepts and terms are clearly explained. Research/analysis of topic is clearly evident. Reader gains new knowledge and insight.	Technical information is at an appropriate level for the course. Some concepts are not completely clarified. Research/analysis of topic is generally evident. Reader gains some new knowledge and insight.	Technical information is at a marginal level for course. Many concepts are unclear or not discussed. Research/analysis of topic is not clear. Reader gains little new knowledge or insight.	Technical information is unacceptable for course. Most concepts are unclear or not discussed. Research/analysis of topic is not present. Reader gains no new knowledge or insight.	
Writing Style/Grammar	Grammar is very good. Writing style is clear, concise, and effective.	Grammar is good. Some writing errors evident that neither hinders clarity nor distracts the reader.	Grammatical mistakes are noticeable. Significant writing errors are present that hinders clarity and/or distracts the reader.	Many grammatical mistakes. Writing errors obscure clarity and distract the reader.	
Quotation/Citation	All quotes are properly formatted and cited. Appropriate paraphrasing and/or summarizing of sources is used.	Most quotes are properly formatted and cited. Paraphrasing and/or summarizing is adequate, with only a few errors.	Few quotes are properly formatted or cited. Replacement of words with synonyms is used instead of proper paraphrasing and/or summarizing a source.	Direct quotes are used without quotation marks and/or citation. Paraphrasing and/or summarizing is non-existent or not properly done.	
Appearance	Document is neat and professional. Formatting guidelines have been precisely followed.	Document is neat and professional. Formatting guidelines have been mostly followed.	Appearance is acceptable, but contains distracting elements. Formatting guidelines have not been followed.	Appearance is unacceptable.	

3g Communication

Tables/Graphs/Images	Tables, graphs, and images are easy to read and follow, and enhances communication. Items are appropriately numbered and referenced in the text (e.g. Table 1 or Image 3).	Tables, graphs, and images are understandable, and adequately convey information. Items are appropriately numbered and referenced in the text (e.g. Table 1 or Image 3).	Tables, graphs, and images are acceptable, but difficult to interpret and/or incompletely convey information. Items are not appropriately numbered and are poorly referenced.	Tables, graphs, and images are inappropriately used, or missing when appropriate. Items fail to convey information. Items are not properly numbered or referenced.	
Equations/ Formulas/ Calculations	All are accurate, and written so they are easy to read. Content and position add to the understanding of the document	Accurate, but may not be easy to read or follow.	Most are accurate.	Many calculations and formulas are incorrect and may lead to incorrect conclusions.	

g2) Prepare and deliver oral presentations.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Organization	Presentation is clear, logical, and well organized. Easy to follow reasoning.	Presentation is generally clear and organized. A few minor points may be confusing.	Presentation is difficult to follow. Many points are unclear. Organization is haphazard.	Listeners are confused. Most points are unclear. Direction and focus of presentation is unclear.	
Content	Technical information is at an appropriate level for the course. Key concepts and terms are clearly explained. Research/analysis of topic is clearly evident. Audience gains new knowledge and insight.	Technical information is at an appropriate level for the course. Some concepts are not completely clarified. Research/analysis of topic is generally evident. Audience gains some new knowledge and insight.	Technical information is at a marginal level for course. Many concepts are unclear or not discussed. Research/analysis of topic is not clear. Audience gains little new knowledge or insight.	Technical information is unacceptable for course. Most concepts are unclear or not discussed. Research/analysis of topic is not present. Audience gains no new knowledge or insight.	
Multimedia/Graphics	Multimedia/graphics clearly enhances presentation.	Multimedia/graphics contributes to the quality of presentation.	Multimedia/graphics poorly prepared or used inappropriately.	Multimedia/graphics so poor as to be distracting.	

3g Communication

Slides/Prepared Content	Most information is easy to see, read, and follow. Grammar is good. Presentation follows formating instructions given by instructor.	Information is generally easy to see, read, and follow. Grammar is good. Presentation generally follows formating instructions given by instructor.	Information is difficult to see, read, and follow. Grammatical mistakes are noticeable. Presentation does not really follow formating instructions.	Information is unclear and/or illegible. Many grammatical mistakes. Presentation does not follow formating instructions	
Delivery	Voice is projected and easy to hear. Transitions well from slide to slide.	Voice is mostly projected and can almost always be heard. Transitions are for the most part good.	Voice is not well projected and is difficult to hear at times. Transitions are cumbersome.	Voice cannot be heard for most of the presentation. Transitions are non-existent or distracting.	
Body Language	Speaks to the audience.	Generally speaks to the audience.	Tends to speak away from the audience (e.g. looking at floor, screen, etc.).	Speaks mostly away from the audience (e.g. at screen or at floor).	
Time Management	Pace is smooth. Does not significantly exceed or present for less than the allocated time.	Pace is good with a few breaks. Somewhat exceeds or presents for less than the allocated time.	Several noticeable breaks in paces. Exceeds or presents for less than the allocated time.	No real pace at all. Significantly exceeds or presents for less than the allocated time.	
Question & Answer	Answer adequately and without hesitation, including acknowledgment of lack of knowledge when appropriate.	Answers adequately, with some hesitation, including acknowledgment of lack of knowledge when appropriate.	Answers are not always adequate. Hesitates with noticeable pauses. Does not acknowledge lack of knowledge where appropriate.	Questions are not answered or are answered with great difficulty. Hesitates with significant, uncomfortable pauses. Does not acknowledge lack of knowledge where appropriate.	

3h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**h1) Understand the impact of engineering solutions on society and the environment in a global economic context.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Understand impact	Can clearly explain the impact engineering solutions have on the global, economic, environmental, and social contexts	Can clearly explain the impact engineering solutions have on more than two non-technical contexts	Can explain the explain the impact engineering solutions for at least two non-technical contexts. Some explanations make be weak and not fully demonstate understanding.	Can only explain the impact engineering solutions have on one non-technical contexts. Explanation make be weak and not fully demonstate understanding.	

h2) Understand and explain non-technical issues related to global, economic, environmental, and societal contexts.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Explain contexts	Can clearly explain the issues and complexities related to all non-technical contexts	Can clearly explain the issues and complexities related to more than two non-technical contexts	Can explain the issues and complexities related to at least two non-technical contexts. Some explanations make be weak and not fully demonstate understanding.	Can only explain the issues and complexities related to one non-technical contexts. Explanation make be weak and not fully demonstate understanding.	

h3) Consider a variety of available options in engineering design and make a proper choice based on their impact.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Evaluate options	Engineering option analysis and solution selection shows deep understanding of the global, economic, environmental, and societal context	More than two non-technical considerations are evaluated while selecting engineering solutions. Explanations demonstrate understanding of the complexities of the impact	More than one non-technical consideration is evaluated while selecting engineering solutions, but some appear to be "afterthoughts" that are not thoroughly explained	Only one context is considered in engineering solutions - for example environmental or economic	

3i. A recognition of the need for, and an ability to engage in life-long learning**i1) Carry out research on engineering topics by reading and reporting on papers in the technical literature.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Ability to engage in life-long learning	Fully incorporates information from multiple, high-quality, outside sources of information. Clearly explains why sources were chosen, why they were high-quality, and why they were appropriate for the assignment.	Identifies the top 2 or 3 sources of information, explains why chosen, and incorporates into assignments	Incorporates information from at least one outside resource other than Wikipedia into assignments. Little or no "vetting" of the resources	Over-reliant on a few sources of information - for example Wikipedia. Little or know evaluation of the validity, accuracy, or applicability of the source	

i2) Involve oneself in professional activities (e.g. meeting, presentations, workshops).

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Need for life-long learning	Demonstrates responsibility for creating own learning opportunities. Realizes that they will need to know different things either because their situation or focus changes or because body of knowledge is growing. Articulates a personal plan for future learning	Is able to articulate that the degree is just the foundation of what they will need to know in the future. Realizes they will need to continue their education beyond provided information.	Will use outside resources when reminded, but doesn't seek them out on their own	Complains about not being given enough information to complete the assignment and shows little interest in outside learning resources	

3j Contemporary

3j. A knowledge of contemporary issues

j1) Identify and discuss emerging technologies related to computer and electrical engineering.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Knowledge on emerging technologies	Can discuss the importance of emerging technologies and clearly identify the most important ones.	Has decent knowledge on emerging technologies and can discuss their importance.	Has little knowledge on emerging technologies and cannot properly identify the more important technologies.	Has almost no knowledge on emerging technologies.	

j2) Identify recent trends in computer and electrical engineering.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Knowledge on recent trends	Can discuss the importance of recent trends in computer and electrical engineering and identify their impact.	Has decent knowledge on recent trends in computer and electrical engineering and can discuss their impact.	Has little knowledge on recent trends in computer and electrical engineering and cannot properly identify the more important trends.	Has almost no knowledge on recent trends in computer and electrical engineering.	

j3) Understand the relation of classical topics in engineering with their implementation in modern technologies.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Understand the impact of classical engineering topics on modern technologies	Fully understand the connection between the classical engineering topics and current technologies.	To some extent understand how the classical engineering topics impact current technologies but not completely see the connection.	Has little knowledge on how the classical engineering topics impact current technologies.	Has no clue on how the classical engineering topics impact current technologies.	

3k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**k1) Use appropriate tools, simulation software, or hardware design tools to solve engineering problems.**

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Use of appropriate tools	Demonstrates advanced use of appropriate tools above basic knowledge obtained in class, applies software tools to improve upon a solution to a problem.	Demonstrates acceptable use of appropriate tools when needed to solve a problem.	Uses appropriate tools when necessary, but does not appear to grasp its full potential. Relies on other tools if possible.	Avoids use of appropriate tools and has a difficult time using them when required.	

k2) Utilize appropriate software and hardware measurement and test equipment.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Use of measurement and test equipment	Demonstrates advanced use of appropriate measurement and test equipment above basic knowledge obtained in class, applies software tools to improve upon a solution to a problem.	Demonstrates acceptable use of appropriate measurement and test equipment when needed to solve a problem.	Uses appropriate measurement and test equipment when necessary, but does not appear to grasp its full potential. Relies on other tools if possible.	Avoids use of appropriate measurement and test equipment and has a difficult time using them when required.	

k3) Determine the appropriate choice of tools when several are available.

	4 Exemplary	3 Proficient	2 Apprentice	1 Novice	Score
Choose appropriate tool	Always identify the best available tool after careful consideration of all the options.	Most of the time identify the best available tool.	Sometimes fail to choose the right tool. Does not spend sufficient time on studying the available tools.	Act indifferent in choosing engineering tools or fail to identify the right tool.	