

Outcome (a) Rubrics

Ability to apply knowledge of mathematics, science, and engineering to obtain solutions and formulate models of processes and systems.

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	
				<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
ability to apply mathematics, science, and engineering		Always uses the proper mathematical, and scientific formulation to solve problems	Uses the proper mathematical, and scientific formulation to solve problems most of the times	Uses the proper mathematical, and scientific formulation to solve problems some of the times	Rarely uses the proper mathematical, and scientific formulation to solve problems

Outcome (b) Rubrics

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

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Identifying clear goals for the experiment		Clearly identify the objectives of the experiment, the expected results, and possible pitfalls to watch for	Clearly identify the objectives of the experiment and some of the expected results but does not think of the possible pitfalls	Identify some of the objectives of the experiment but omits the expected results and possible pitfalls	Does not identify any objectives for the experiment and/or expected results
Choosing the appropriate experimental test bed (Hardware, Software, Emulation, Simulation, or hybrid) to achieve the identified objectives of the experiment		Chooses the best test bed suitable for achieving the objectives with proper justification	Chooses the best test bed suitable for achieving the objectives with no justification	Chooses a test bed that is not optimum but somehow achieves the identified objectives	Chooses a test bed that does not achieve the objectives at all
Designing and conducting the experiment		Student groups design and conduct the experiment with no errors at all	Student groups design and conduct the experiment with some minor errors that do not adversely affect the objectives	Student groups design and conduct the experiment with some errors that affect the results and the objectives	Student groups design and conduct the experiment with major conceptual or procedural errors that render the results useless and leave the objectives unachieved
Ability to analyze and interpret the data		Analysis and interpretation of results exceed requirements of experiment and demonstrate significant higher-order thinking ability	Analysis and interpretation of results meet requirements of experiment and demonstrate some higher-order thinking ability	Results are analyzed but not interpreted; very limited evidence of higher-order thinking ability	No evidence of significant analysis and interpretation of results; fail to meet requirements of the experiment; demonstrate only lower-level thinking ability

Outcome (c) Rubrics

**Ability to design a system, process, or component to meet desired needs subject to given constraints.
Analyze and evaluate alternative solutions.**

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #

Evaluator's Input

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
<p>Requirements are translated accurately and with great precision into system behavior and features clearly described without ambiguity and without entering into any design details</p>		<p>Requirements are translated accurately and with great precision into system behavior and features clearly described without ambiguity and without entering into any design details.</p>	<p>Requirements are translated accurately into system behavior and features clearly described with some ambiguity. The description of behavior and features enters into some details and proposes design solutions thinking it is just translating the requirements.</p>	<p>Requirements are not translated accurately into system behavior and features. Some features not clearly described. Some consistency errors.</p>	<p>Specification does not follow the requirements consistently. Several consistency errors. No clear difference between system behavior description and features and design solutions.</p>
<p>Potential conceptual problems are addressed and properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly or alike</p>		<p>Potential conceptual problems are addressed and properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly or alike</p>	<p>Potential conceptual problems are addressed but not properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly with some errors on the assumptions.</p>	<p>Potential conceptual problems are recognized but not properly formulated. No system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly.</p>	<p>Potential conceptual problems are not identified in any way.</p>

Outcome d Rubrics have 2 parts d(i) and d(ii)

Outcome d(i) Rubrics

**Ability to function on multi-disciplinary and/or diverse teams.
Take responsibility, share work, and value other viewpoints.**

(Our interpretation of multidisciplinary teams includes teams of individuals with similar educational backgrounds focusing on different aspects of a project as well as teams of individuals with different educational backgrounds).

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	Evaluator's Input

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Contributions		Routinely provides useful ideas when participating in the group and in classroom discussion. <u>A leader who contributes a lot of effort.</u>	Usually provides useful ideas when participating in the group and in classroom discussion. <u>A strong group member who tries hard!</u>	Sometimes provides useful ideas when participating in the group and in classroom discussion. <u>A satisfactory group member who does what is required.</u>	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Problem-solving		Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems.
Attitude		Is never publicly critical of the project or the work of others. <u>Always has a positive attitude about the task(s).</u>	Is rarely publicly critical of the project or the work of others. <u>Often has a positive attitude about the task(s).</u>	Is occasionally publicly critical of the project or the work of other members of the group. <u>Usually has a positive attitude about the task(s).</u>	Is often publicly critical of the project or the work of other members of the group. <u>Is often negative about the task(s).</u>

Outcome (e) Rubrics

Ability to Identify, formulate, and solve engineering problems. Make appropriate and necessary assumptions. Suggest and evaluate new approaches.

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #		
				Evaluator's Input	

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Applying concepts, governing math or physics equations and algorithms to solve a problem		Applies correct concepts, chooses correct governing equations and optimum algorithms (or methods) to solve a problem.	Applies correct concepts, chooses correct governing equations but use sub-optimum algorithms (or methods) to solve a problem.	Applies some correct concepts and chooses some correct governing equations but makes mistakes	Applies incorrect concepts and/or chooses incorrect governing equations → can not solve problems
Demonstrating effective open-ended problem solving techniques (including the debugging of a faulty design; hardware, software or both)		Always solves problems using step-by-step logical procedure and obtain correct solution	Mostly solves problems using step-by-step logical procedure. Sometimes he solves problems in an ad-hoc manner, but still he obtains correct solutions	Mostly solves problems using step-by-step logical procedure but some times makes minor procedural errors that lead to incorrect solution of the problem	Solves problems without logical step-by-step logical procedure and makes procedural errors resulting in incorrect solution

Outcome (f) Rubrics

Ability to understand professional and ethical responsibilities. Demonstrate ethical practice.

Representative Student's Name	ID #	Term (e.g., T071)	Lab or Course #	<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Understanding of ethical and professional issues		Deep understanding of the professional issues involved and the ethical implications of the solution; careful, convincing analysis of all relevant factors	Good understanding of all the professional/ethical issues related to the solution; reasonable analysis of the relevant issues	Some consideration of professional, ethical issues raised directly by the solution	Little or no understanding of professional/ethical issues even where there are serious questions involved

Outcome g rubrics have 2 parts g-O and g-W

Outcome (g-O) Rubrics Ability to communicate effectively - Oral

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	Evaluator's Input

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Audience awareness: interacts with audience (e.g. stepping towards audience and speaking to them, not at them), looking at them, making eye contact		Interacts with audience throughout presentation	Some interaction with audience	Little interaction with audience	Does not interact with audience at all ... Does not look at the audience ... Look at PC, screen, or elsewhere
Focus: goal, evidence, conclusion (gives audience a roadmap and follows it)		Gives audience very clear road map of goal, evidence and conclusion	Gives audience an adequate road map of goal, evidence and conclusion	Gives audience some road map of goal, evidence and conclusion	Does not give audience an adequate road map of goal, evidence and conclusion
Transitions: phrases smoothly link one part to next		Very smooth Transitions	Transitions are generally smooth	Some transition is provided though not smooth	Abruptly transitions from one phase to the next ... No linking
Use of visual aids (any non-plain text methods such as graphs, charts, flow diagrams ...etc.) to tell the story and enhance the quality of the presentation		Uses visual aids very effectively to tell the story; visual aids enhance presentation	Overall, uses visual aids effectively to tell the story; visual aids add to presentation	There is some use visual aids effectively to tell the story	Either does not use visual aids at all; or too much dependency on visual aids

Mechanics	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Body position (e.g., facing audience or screen)		Always facing audience	Faces audience most of the time	Faces audience some of the time	Faces screen or board all the time
Eye contact (e.g., scanning entire audience)		Eye contact (excellent scanning of audience, looking at people)	Eye contact (some scanning of audience, looking at people)	Some eye contact (not enough, looking down a lot)	No eye contact

Visual aids (e.g., clear, not too busy, readable size font)		Clear, right amount on each slide	Can read clearly, usually not too much material	A little bit busy, sometimes not clear	Too busy, blurry
Delivery (e.g., fluency, pace, voice projection, um's, uh's)		Excellent pace, projects voice, great enthusiasm	Good pace, usually projects voice, some enthusiasm	A little bit fast, sometimes um's, little projecting voice, little enthusiasm	Too fast, too many um's, not projecting voice, lack of enthusiasm

Questions	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Asks audience for questions		Effectively opens ("I'd be happy to answer questions")	Asks for questions	rarely asks for questions	Does not ask for questions
Answers questions effectively and smoothly		Answers questions effectively and smoothly	Answers questions adequately	rarely answers questions adequately	Does not answer questions adequately

Outcome (g-W) Rubrics

Ability to communicate effectively - Written

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #

Evaluator's Input

Report Quality & Writing Skills	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Spelling and Grammar		Almost no spelling and/or grammatical mistakes (≤ 0.2 mistake/page)	Rare spelling and/or grammatical mistakes (≤ 0.5 mistake/page)	Makes noticeable spelling and/or grammatical mistakes (≤ 1 mistake/page)	Makes frequent spelling and/or grammatical mistakes (≥ 1 mistake/page)
Punctuation		Proper use of punctuation, sentences are not too long, no repetition of words, proper use of paragraphs	Proper use of punctuation, sentences are sometimes too long, some repetition of words, proper use of paragraphs	Some improper use of punctuation, sentences are usually too long, many repetition of words, some improper use of paragraphs	No use of punctuation at all ... Sentences seems to go on and on for ever ... No apparent usage of paragraphs
Structure and Organization (choice of fonts, titles, sub-titles, chapters, sub-chapters, sections, sub-sections to enhance the readability and understanding of the report), having a table of content, list of Figures and tables		Superb structure of the report, everything makes sense (understand templates and can follow them exactly), perfect table of content, list of figures and tables	Good Structure and organization with some departure from the ideal template, good table of content, list of figures and tables	The structure and organization are not good ; noticeable departure from template, poor table of content, list of figures and tables	The structure and organization of the report seem to be random ; does not follow the template at all, missing table of content, list of figures or tables
Use of visual illustrations, other than plain text, (graphs, charts, flow diagrams, tables ...) to enhance the understanding of the report		All information that can be represented graphically is presented as such with proper choice of the illustration method that suits the information being presented the most	Most information that can be represented graphically is presented as such with good choice of the illustration method that suits the information being presented the most	Most information that can be graphically illustrated is presented as plain text . Some information is illustrated graphically with some wrong illustration methods	Information is rarely illustrated graphically with improper choice of illustration methods

<p>Formulae and equations</p>		<p>All formulae and equations used are properly written, numbered and referenced</p>	<p>Most formulae and equations used are properly written, numbered and referenced</p>	<p>Most formulae and equations used are properly written but many are not numbered and referenced</p>	<p>Many formulae and equations used are improperly written and most of them are not numbered and referenced</p>
<p>Proper use of References</p>		<p>All information obtained from others is properly referenced. The list of references is properly documented (source name, publication name, page numbers, ...etc.)</p>	<p>Most information obtained from others is properly referenced. The list of references is properly documented (source name, publication name, page numbers, ...etc.)</p>	<p>Some use of references, most information is not referenced. List of references is not properly documented (some information is missing, like page numbersetc.)</p>	<p>No referencing at all</p>
<p>Proper use of appendices (to reduce the size of the main body of the report)</p>		<p>All the information that is not critical to the understanding of the report but might be of some interest to some of the readers is put in the appendices. Appendices are properly organized (multiple appendices are used for different information)</p>	<p>Most of the information that is not critical to the understanding of the report but might be of some interest to some of the readers is put in the appendices. Appendices are properly organized (multiple appendices are used for different information)</p>	<p>Most of the information that can be put in appendices are spread through the main body of the report. Only one (or few) appendices are included containing many, unrelated, information</p>	<p>No use of appendices at all. Everything is in the main body of the report</p>

Technical Contents	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
The abstract		Precise, completely conveys what has been accomplished, provide performance numbers with a good first punch line	Completely conveys what has been accomplished, provide performance numbers, no punch line, too many words	Somehow conveys what has been accomplished ... No performance numbers	No abstract at all or what is provided as an abstract is not an abstract!
Problem description and motivation		The problem being tackled is clearly described with proper usage of statistics, market surveys, news articles ...etc. to support the motivation for tackling this problem	Clear problem description but vague (or little support) motivation	Somehow vague problem description, no motivation or justification for tackling this problem at all	Vague problem description (one can not tell exactly what he is trying to do or why)
Objectives & Deliverables		Measurable objectives and deliverables are clearly and precisely stated	Objectives and Deliverables are stated with some vagueness (making them less measurable)	Some objectives and deliverables are provided (many are missing), however they are not clear nor measurable	Objectives 7 deliverables are not stated at all

<p>Project Management Plan</p>		<p>A well written work plan is provided detailing phases or milestones, tasks, task assignment, task duration, critical path analysis and contingency plans, required resources, and discrepancies between planned and achieved tasks. Tasks are clearly and precisely stated (one can tell what is the expected outcome of a task just by reading the task)</p>	<p>A work plan is provided with some details about tasks (no phases or milestones), tasks, task assignment, task duration, required resources, and discrepancies between planned and achieved tasks. No critical path analysis and contingency plans. Some tasks are vaguely stated (one can not tell what is the expected outcome of a task just by reading the task)</p>	<p>A very brief work plan is provided with very little description of tasks. Tasks are very vague.</p>	<p>No work plan is provided at all</p>
<p>Quality of Engineering Documentation</p>		<p>Engineering principles are well developed, possible solutions are well documented, proper description of solution, proper documentation of experimental setup, data acquisition, analysis, results, testing, benchmarking (all that apply), and conclusions.</p>	<p>Generally sufficient documentation of possible solutions, adopted solution, experimental setup, data acquisition, analysis, results, testing, benchmarking (all that apply), and conclusions. Some items might not be sufficiently documented.</p>	<p>Some documentation is provided but some major components are missing</p>	<p>Documentation is generally inadequate</p>

Outcome (h) Rubrics

Understanding of the impact of engineering solutions in a global, economic, environmental, and societal context

Representative Student's Name	ID #	Term (e.g., T071)	Lab or Course #	<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Awareness of global effects of engineering solutions (product, practice, event)		Deep understanding of the immediate and long-term issues involving the solution on users and non-users locally and globally	Good understanding of the widespread effects of the solution but with somewhat limited perspective about long-term factors	Some awareness of the more extended effects of the solution	Seems to have considered only effects on immediate users
Understanding of economic factors		Deep understanding of economic factors applied to this and related solutions and the impact they may have on the economy at large as well as long term trends	Good understanding of economic factors as applied to this solution and how it affects other related solutions	Some understanding of economic factors as applied to the solution	Little or no understanding of economic factors involved in the creation and/or use of the solution
Awareness of implications to society at large		Deep understanding of the immediate and long term implications to society in the creation and/or use of the solution, and the overall potential benefits and risks to society.	Good understanding of the implications to society in the creation and/or use of the solution, as well as its relation to general societal issues	Moderate understanding of the implications to society in the creation and/or use of the solution	Little or no understanding of (or interest in?) implications to society involved in the creation and/or use of the solution

Outcome (i) Rubrics

Recognize the need for, and an ability to engage in, life-long learning

(Our interpretation of this includes teaching students that the underlying theory is important because the technology changes, coupled with enhancing their self-learning ability)

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	
				Evaluator's Input

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Importance of lifelong learning		Demonstrates extensive understanding of the importance of lifelong learning	Demonstrates substantial understanding of the importance of lifelong learning	Demonstrates basic understanding of the importance of lifelong learning	Demonstrates little or no understanding of the importance of lifelong learning.
Independency		Routinely demonstrate the ability to find, evaluate and use resources to learn independently	Usually demonstrate the ability to find, evaluate and use resources to learn independently	sometimes demonstrate the ability to find, evaluate and use resources to learn independently	Rarely demonstrate the ability to find, evaluate and use resources to learn independently
Personal responsibility		Displays exceptional recognition of the need to accept personal responsibility	Displays sufficient recognition of the need to accept personal responsibility	Displays minimal recognition of the need to accept personal responsibility	Does not recognize the need to accept personal responsibility
Critical Thinking		Demonstrate the ability to: <ul style="list-style-type: none"> o Gather new data, use information well, understands concepts within standards. o Know and understand the facts, new thoughts developed on basis of new information. o Use information/knowledge used in multiple "real" contexts. 	Demonstrate the ability to: <ul style="list-style-type: none"> o Gather new data, use information well, understands concepts within standards. o Know and understand the facts, new thoughts developed on basis of new information. 	Demonstrate the ability to: <ul style="list-style-type: none"> o Gather new data, use information well, understands concepts within standards. 	Demonstrate the ability to gather new data
Decision making		Demonstrates in-depth level of engagement and decision making skills	Demonstrates appropriate decision making skills	Demonstrates some level of decision making skills	Demonstrates little or no level of decision making skills

Accepting new Challenges		Displays exceptional capability to accept new challenges	Displays substantial capability to accept new challenges	Displays minimal capability to accept new challenges	Displays little or no capability to accept new challenges
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Outcome (j) Rubrics

Knowledge of contemporary issues

(Our interpretation of this includes presenting students with issues such as the impact of globalization, the outsourcing of both engineering and other support jobs as practiced by modern international companies).

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #

<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Awareness of (other) contemporary issues (political, cultural, ...)		Deep understanding of all the relevant contemporary issues related to the creation and/or use of the solution, as well as of issues that may be only tangentially related; good analysis of all these issues and how they might impact the general acceptance of the solution and how this might affect the future development of similar solutions.	Good understanding of all the relevant contemporary issues directly related to the creation and/or use of the solution.	Moderate understanding of the main relevant contemporary issues directly related to the creation and/or use of the solution	Little or no understanding of (or interest in?) contemporary issues directly related to the creation and/or use of the solution

Outcome (k) Rubrics

Use the techniques, skills, and modern engineering tools necessary for engineering practice

Representative Student's Name	ID #	Term (e.g., T112)	Lab or Course #	<i>Evaluator's Input</i>

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Tool Selection		Selection of tools is based on sound technical criteria. Relevant industry standard class tools (software CAD, simulation, test equipment, emulators, measurement and lab equipment, planning and project management tools) are selected for carrying out specific tasks	Selection of tools is based on prior knowledge of the tools. Relevance of the selected tools is close to the standard practices.	Selection of tools is not based on technical criteria. Tools are selected based on personal preference	Selection of tools is not discussed. Use of the wrong set of tools is commonly noticed.
Tool Usage		Usage of the tools shows a good awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Any issue with the tools is resolved using the tools documentation, FAQs or the customer support. Accurate description of credible problems encountered is noticed.	Usage of the tools is shows a fair awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Some issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is not always seen.	Usage of the tools is shows a little awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Improper use of the tools documentation. Several issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.	Usage of the tools is shows no awareness of the tools capabilities and features. Tools are used incorrectly and in an inconsistent way with the stated objectives. Improper use of the tools documentation. Most issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.

SO1: an ability to *identify, formulate, and solve* complex engineering problems by *applying* principles of *engineering, science, and mathematics*.

Indicator	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Engineering problem identification and formulation		Captures the complete set of design specifications for an engineering problem.	Captures most of the design specifications for an engineering problem but misses some of the design specifications.	Captures some of the design specifications for an engineering problem but misses most of the design specifications.	Unable to capture the design specifications for an engineering problem.
Applying concepts, governing math or physics equations and algorithms to solve an engineering problem		Applies correct concepts, chooses correct governing equations and optimum algorithms (or methods) to solve an engineering problem.	Applies correct concepts, chooses correct governing equations but use sub-optimum algorithms (or methods) to solve an engineering problem.	Applies some correct concepts and chooses some correct governing equations but makes mistakes.	Applies incorrect concepts and/or chooses incorrect governing equations, or cannot solve problems.

SO2: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.

Performance Indicator	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
<p>Requirements: User's needs</p> <p>Specifications: What designers need to target are properly identified and stated.</p>		<p>Requirements are clear and represent all stakeholders' needs (users, public, environment etc.)</p> <p>Properly translated to specifications (system, sub-systems) with adequate precision/resolution</p>	<p>Requirements are mostly correct but missing some non-user requirements (e.g. missing health, environment, legal requirements)</p> <p>Translated into right specs with minor errors in precision and/or resolution.</p>	<p>Some requirements are stated but many are missing, some vagueness. No consideration of non-user requirements. The specs are incomplete with many requirements not mapped to any spec.</p>	<p>Very few requirements, mostly vague and incomplete, some design decisions appear in the requirements (shows misunderstanding), specs are not directly relatable to requirements.</p>
<p>Approach Selection</p>		<p>All possible approaches are identified, properly analyzed (Pros * Cons) and the most suitable one selected with proper justification (using appropriate decision criteria). Criteria include economic (cost), and other factors.</p>	<p>Most possible approaches are identified and analyzed. The selection process does not give clear (convincing justification) or incomplete criteria are used in the decision making process.</p>	<p>Some possible approaches are identified. Student recognize that the selection should follow a certain process but chose inappropriate criteria or use flawed logic to make the selection.</p>	<p>Only one approach is identified and selected with almost no decision making process.</p>
<p>System Design</p>		<p>System's behavior is correctly identified and documented, system's architecture is properly developed and documented, and a proper physical deployment of the system is devised to satisfy</p>	<p>System's behavior is correctly identified and documented, some system's architecture is proposed but is not ideal or more of a structural view of the system, the proposed physical deployment of the</p>	<p>System's behavior is missing some <i>minor</i> use cases (other than the main use cases), no architectural view just physical deployment representation, documentation is incomplete.</p>	<p>System's behavior is missing some <i>major</i> use cases, no architectural view, the physical deployment is missing major components or very naive, almost no</p>

		all requirements and specifications.	system is not satisfying some of requirements and specifications.		documentation or incomplete documentation.
Detailed Design		Requirements and system specs are properly translated to component specs, components design/selection follows best known methods (proper design decisions), proper tools are used for the design and verification of components. All relevant standards are considered and properly taken into account in the design.	Requirements and system specs are translated to component specs but some specs are missing, components design/selection follows best known methods except for some components (e.g. unjustified decisions or mistakes), proper tools are used for the design but lacking in verification of components. Some but not all standards are taken into account.	Components are designed/selected in an ad-hoc trial and error manner (specs are not derived beforehand). Inferior design techniques, little use of tools or use of improper tools leading to design mistakes, no verification, some evidence of following standards but no mention of standards compliance.	Very little design of components. Missing components, little or no use of tools at all no evidence of understanding standards at all.
Prototyping		Proper integration of all components, prototype is a truthful representation of the end product (almost production quality), proper emulation of non-available components, proper documentation and demonstration of final prototype.	Proper integration of most components, prototype contains more emulated components than it should but still a truthful representation of the end product, not all use cases are properly documented and demonstrated.	Little integration (prototype is made of disjoint systems that are demonstrated separately), many unnecessarily emulated components, prototype is far from the end product, poor documentation.	No prototype, just some demonstrated components, poor documentation.

S03: an ability to communicate effectively with a range of audiences.

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
<p><u>Oral Communication:</u></p> <p>1. Presentation skills:</p> <ul style="list-style-type: none"> - clear voice and tone - interaction with audience - eye contact - body language 		Speaks fluently and effectively with excellent tone and pace, interacts with audience, and uses proper eye contact and body language.	Speaks clearly and effectively with proper tone and pace, interacts - at times - with audience, and uses moderate eye contact and body language.	Speaks fairly with moderate tone and pace, uses little interaction with audience, and uses little eye contact and body language.	Speaks poorly with improper tone and pace, doesn't interact with audience, and uses no eye contact or body language.
<p>2. Presentation Material and Organization:</p> <ul style="list-style-type: none"> - outline - structure - visual aids - transition - evidence and conclusion - questions 		Presents and follows an excellent outline and organization, makes smooth transitions, uses visual aids effectively, presents convincing evidences and conclusions, and answers questions effectively.	Presents and follows an satisfactory outline and organization, makes adequate transitions, uses visual aids reasonably, presents some convincing evidences and conclusions, and answers questions moderately.	Presents a fair outline and organization, makes uneven transitions, uses some visual aids improperly, presents few convincing evidences and conclusions, and answers questions barely.	Presents a poor outline and organization, makes rough transitions, uses visual aids poorly, presents no convincing evidences or conclusions, and answers questions poorly.
<p><u>Written Communications:</u></p> <p>1. Language</p> <ul style="list-style-type: none"> - spelling - grammar - punctuation - sentence structure 		Makes rare or no spelling and/or grammatical mistakes, excellent use of punctuation, and smooth and well-structured sentences.	Makes few spelling and/or grammatical mistakes, proper use of punctuation, and moderately smooth and structured sentences.	Makes noticeable mistakes in spelling, grammar and/or in the use of punctuation, and uses weakly structured sentences.	Makes substantial mistakes in spelling, grammar and/or in the use of punctuation, and uses poorly structured sentences.
<p>2. Organization</p> <ul style="list-style-type: none"> - organization - abstract - visual aids - bibliography 		Follows a clear organization, uses an effective and accurate abstract, uses visual aids effectively, and cites all sources properly.	Follows an acceptable organization, uses a good abstract, uses visual aids with varying effectiveness, and cites most sources properly.	Follows a less than acceptable organization, uses an inaccurate abstract, uses visual aids barely, and cites some sources.	Follows a poor organization, uses an inaccurate or no abstract, uses visual aids ineffectively, and does not cite most sources.

<p>3. Effectiveness</p> <ul style="list-style-type: none"> - readability - motivation - problem description - rigor - documentation - conclusion 		<p>Produced a smoothly readable document, with a catching motivation and problem description, rigorous use of scientific concepts and/or equations, a complete documentation, and sounding conclusions.</p>	<p>Produced a readable document, with adequate motivation and problem description, some rigorous use of scientific concepts and/or equations, adequate documentation, and fair conclusions.</p>	<p>Produced a partially readable document, with fair motivation and problem description, some mistakes in the use of scientific concepts and/or equations, partial documentation, and partially convincing conclusions.</p>	<p>Produced a barely readable document, with poor motivation and problem description, frequent mistakes in the use of scientific concepts and/or equations, poor documentation and poor conclusions.</p>
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Student Outcome (4) Rubric: 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.

Performance Indicator	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Awareness of global effects of engineering solutions (product, practice, event)		Deep understanding of the immediate and long-term issues involving the solution on users and non-users locally and globally	Good understanding of the widespread effects of the solution but with somewhat limited perspective about long-term factors	Some awareness of the more extended effects of the solution	Seems to have considered only effects on immediate users
Understanding of ethical and professional issues		Deep understanding of the professional issues involved and the ethical implications of the solution; careful, convincing analysis of all relevant factors	Good understanding of all the professional/ethical issues related to the solution; reasonable analysis of the relevant issues	Some consideration of professional, ethical issues raised directly by the solution	Little or no understanding of professional/ethical issues even where there are serious questions involved
Awareness of Contemporary issues (Social, Economic, Political, others ...)		Deep understanding and good analysis of ALL relevant issues and how they might impact the general acceptance of the solution and how this might affect the future development of similar solutions	Good understanding of directly relevant contemporary issues to the creation and use of the solution.	Moderate understanding of the main relevant contemporary issues directly related to the creation and use of the solution	Little understanding of contemporary issues directly related to the creation and use of the solution

SO5: 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.

Performance Indicator	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Contributions		Routinely provides useful ideas when participating in the group and in classroom discussion. <u>A leader who contributes a lot of effort.</u>	Usually provides useful ideas when participating in the group and in classroom discussion. <u>A strong group member who tries hard!</u>	Sometimes provides useful ideas when participating in the group and in classroom discussion. <u>A satisfactory group member who does what is required.</u>	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Problem-solving		Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems.
Working with others		Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

Teamwork		<ol style="list-style-type: none"> 1. The project was carried out by more than TWO members 2. The work load and variety on each member seems fair 3. Leadership role being assumed by each member for different tasks is evident 4. Scheduled meetings minutes are Always recorded and the contribution of each team members are identified 	<ol style="list-style-type: none"> 1. The project was carried out by more than TWO members 2. The work load and variety on each member seem fair 3. Leadership role being assumed by each member for different tasks is NOT apparent 4. Scheduled meetings minutes are Usually recorded and the contribution of each team members are identified 	<ol style="list-style-type: none"> 1. The project was carried out by more than TWO members 2. The work load and variety on each member does not seem to be fair or at least one member has been assigned trivial non-technical tasks (e.g. writing the report) 3. Scheduled meetings minutes are Often recorded and the contribution of each team members are NOT identified 	<ol style="list-style-type: none"> 1. The project was carried out by more than TWO members 2. The work load and variety on each member does not seem to be fair or at least one member has been assigned trivial non-technical tasks (e.g. writing the report) 3. Scheduled meetings minutes are Rarely recorded and the efforts are scattered.
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SO6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Pre-Experiment: Identifying clear goals for the experiment – Hypothesis testing, Knowledge Discovery, etc.		Experiment objectives are clear and well articulated, expected results, and possible pitfalls of the experiment	Identifies most of the objectives of the experiment and some of the expected results but does not state possible pitfalls	Identifies some of the objectives of the experiment but omits the expected results and possible pitfalls.	Does not identify any objectives for the experiment and/or expected results
Designing a valid and appropriate experimental setup that achieve the experiment objective		Designs a fully valid testbed suitable for achieving the objectives with proper justification	Designs a valid testbed suitable for achieving the objectives with some justification	Designs a testbed that partially achieve the objectives without enough justification	Fails to designs a valid testbed for achieving the objectives
Conducting the experiment using a well defined valid procedure for achieving the experiment result		Conducts the experiment with no flaws at all, all procedural steps are correct, documented and justified, observations are recorded appropriately.	Conducts the experiment with some minor errors that do not affect the objectives significantly, procedural steps are mostly <i>correct</i> , and documented but not fully justified, observations are recorded appropriately.	Conduct the experiment with some errors that affect the results and the objectives	Conduct the experiment with major conceptual or procedural errors that render the results useless and leave the objectives unachieved
Analyzing and interpreting data and drawing conclusions		Analysis, visualization, interpretation of results, and conclusions exceed requirements of experiment and demonstrate significant higher-order thinking ability.	Analysis, interpretation of results, and conclusions meet requirements of experiment and demonstrate good thinking ability	Results are analyzed but not interpreted; conclusions are drawn but not well supported, very limited evidence of higher-order thinking ability was shown	No evidence of significant analysis and interpretation of results; fail to make proper conclusions; demonstrate only lower-level thinking ability

SO7 an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Performance Indicator	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Capable of recognizing the need for learning new knowledge to solve an engineering problem		The student is <u>fully</u> aware of the exact knowledge that he lacks and that is needed to solve an engineering problem.	The student is <u>mostly</u> aware of the exact knowledge that he lacks and that is needed to solve an engineering problem.	The student is <u>partially</u> aware of the exact knowledge that he lacks and that is needed to solve an engineering problem.	The student is <u>unable</u> to recognize the exact knowledge that he lacks and that is needed to solve an engineering problem.
Capable of using appropriate learning strategies to acquire new knowledge, and applying this knowledge to solve an engineering problem		The student is <u>fully</u> capable of using appropriate learning strategies (such as reading textbooks or technical magazines/journals, watching video tutorials, interacting with technical forums, ...) to acquire the new knowledge that is needed to solve an engineering problem. The student <u>correctly</u> applies the newly acquired knowledge to solve an engineering problem.	The student is <u>mostly</u> capable of using appropriate learning strategies (such as reading textbooks or technical magazines/journals, watching video tutorials, interacting with technical forums, ...) to acquire the new knowledge that is needed to solve an engineering problem. The student applies the newly acquired knowledge to solve an engineering problem but <u>makes minor mistakes</u> .	The student is <u>partially</u> capable of using appropriate learning strategies (such as reading textbooks or technical magazines/journals, watching video tutorials, interacting with technical forums, ...) to acquire the new knowledge that is needed to solve an engineering problem. The student applies the newly acquired knowledge to solve an engineering problem but <u>makes major mistakes</u> .	The student is <u>incapable</u> of using appropriate learning strategies (such as reading textbooks or technical magazines/journals, watching video tutorials, interacting with technical forums, ...) to acquire the new knowledge that is needed to solve an engineering problem. The student is <u>either incapable of applying or incorrectly applies</u> the newly acquired knowledge to solve an engineering problem.