

Examples of Engineering Rubrics*

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University of Alabama at Birmingham	2
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*Rubrics were downloaded from campus websites on January 30, 2006 and were sometimes lightly edited to fit the printed page.

Outcome 1 - Graduates will be able to apply knowledge of mathematics, biology, physiology physical sciences and engineering principles to biomedical engineering applications.

	Level 5	Level 3	Level 1
Mathematical Modeling	Combines mathematical and/or scientific principles to formulate models of chemical, physical and/or biological processes and systems relevant to engineering	Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development	Does not understand the connection between mathematical models and chemical, physical, and/or biological processes and systems in engineering
Application	Applies concepts of integral and differential calculus and/or linear algebra to solve engineering problems	Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving	Does not understand the application of calculus and linear algebra in solving engineering problems
Terms	Shows appropriate engineering interpretation of mathematical and scientific terms	Most mathematical terms are interpreted correctly	Mathematical terms are interpreted incorrectly or not at all
Theory	Translates academic theory into engineering applications	Some gaps in understanding the application of theory to the problem	Does not appear to grasp the connection between theory and the problem
Calculation	Executes calculations correctly by hand and using mathematical software	Minor errors in calculations by hand and applying math software	Calculations not performed or performed incorrectly by hand or does not know how to use math software
Statistical Analysis	Correctly analyzes data sets using statistical concepts	Minor errors in statistical analysis of data	No application of statistics to analysis of data

Outcome 2 - Graduates will be able to use experimental, statistical and computational methods to analyze biomedical engineering problems.

	Level 5	Level 3	Level 1	Score
Computer Usage	Used computer methods effectively	Used computer methods somewhat effectively	Used computer methods somewhat effectively	Did not use computer methods effectively
Experimental Methods	Used experimental methods effectively	Used experimental methods somewhat effectively	Used experimental methods somewhat effectively	Did not use experimental methods effectively
Statistics	Applied statistics effectively	Applied statistics somewhat effectively	Applied statistics somewhat effectively	Applied statistics effectively

Outcome 3 - Graduates will be able to understand the interaction between living and non-living materials and systems.

Level 5	Level 3	Level 1	Score
Biological factors	Understands and can discuss biological factors	Has average knowledge of and can participate in a limited discussion of biological factors	Has limited knowledge or cannot identify any biological factors.

Outcome 4 - Graduates will be able to design and conduct experiments, and analyze and interpret data, including the ability to make measurements on and interpret data from living systems.

	Level 5	Level 3	Level 1
Lab Safety	Observes good laboratory safety procedures	Unsafe lab procedures observed infrequently	Practices unsafe, risky behaviors in lab
Data Gathering	Formulates an experimental plan of data gathering to attain a stated objective (develop correlation, test a model, ascertain performance of equipment, etc.)	Develops a simplistic experimental plan of data gathering, does not recognize entire scope of study (e.g. not all parameters affecting the results are investigated)	No systematic plan of data gathering; experimental data collection is disorganized, even random, and incomplete
Documentation	Carefully documents data collected	Data collected are not all documented, units are missing, or some measurements are not recorded.	Data are poorly documented
Experimental Procedures	Develops and implements logical experimental procedures	Experimental procedures most often followed, but occasional oversight leads to loss of experimental efficiency and/or loss of data	Does not follow experimental procedure
Tool Selection	Can select appropriate equipment and instruments to perform the experiment	Needs some guidance in selecting appropriate equipment and instrumentation	Cannot select the appropriate equipment and instrumentation required to run the experiment(s)
Tool Operation	Is able to operate instrumentation and process equipment	Is tentative in operation of instruments and process equipment.	Does not operate instrumentation and process equipment, does so incorrectly or requires frequent supervision
Analysis and Theory Application	Analyzes and interprets data carefully using appropriate theory; if required, translates theory into practice or applies to process model(s)	Applies appropriate theory to data when prompted to do so, but misinterprets physical significance of theory or variable involved; makes errors in unit conversions	Makes no attempt to relate data to theory
Measurement Error	Is aware of measurement error and is able to account for it statistically	Is aware of measurement error but does not account for it statistically or does so at a minimal level	Is unaware of measurement error

Additional Sources	Seeks information for experiment(s) from multiple sources	Seeks information for experiment(s) from a few sources - mainly from the textbook or the instructor	Seeks no extra information for experiments other than what is provided by instructor
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Outcome 5 - Graduates will be able 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.

	Level 5	Level 3	Level 1
Design Strategy	Develops a design strategy, including a plan of attack, decomposition of work into subtasks, development of a timetable	Uses a design strategy with guidance	No design strategy; haphazard approach
Solutions (a)	Suggests new approaches and improves on what has been done before	Can follow a previous example competently	Cannot design processes or individual pieces of equipment without significant amounts of help
Solutions (b)	Develops several potential solutions and finds optimum	Can develop and compare multiple solutions to a problem, but does not usually arrive at the best result; conducts optimization but neglects one or two key aspects.	Only focuses on one solution to a problem; no optimization attempted.
Integration	Understands how areas interrelate and demonstrates ability to integrate prior knowledge into a new problem. Thinks holistically: sees the whole as well as the parts	Can use prior knowledge to design individual pieces of equipment competently when guided to do so. Does not think holistically: does not see the integration of the pieces clearly	Unable to relate prior knowledge to the design problem. Has no concept of the process as a sum of its parts
Tools	Uses computer tools and engineering resources effectively	Minimal or incorrect use of computer tools and engineering resources	No use of computer tools and engineering resources
Documentation	Supports design procedure with documentation and references	Design is done, but procedures and equations are not documented or referenced	Design is done incompletely without the proper equations and without references
Constraints	Develops a solution that includes economic, safety, environmental and other realistic constraints	Includes only minor or cursory consideration of economic, safety, and environmental constraints	No consideration of economics, safety, and environment
Engineering Application	Applies engineering and/or scientific principles correctly to design practical processes	Applies engineering and/or scientific principles incompletely or incorrectly to design a practical process	No application of engineering and/or scientific principles
Practicality	Recognizes practical significance of design outcome/answer	Gives an answer, but does not check its practicality	Design is incomplete, no answer is given

Outcome 6 - Graduates will be able to function on multi-disciplinary teams

	Level 5	Level 3	Level 1
Attendance/Contribution	Routinely present at team meetings or work sessions. Contributes a fair share to the project workload	Absent occasionally, but does not inconvenience group. Sometimes depends on others to complete the work; contributes less than fair share	Is absent from team meetings or work sessions >50% of the time
Preparation	Is prepared for the group meeting with clearly formulated ideas	Prepares somewhat for group meetings, but ideas are not clearly formulated	Routinely fails to prepare for meetings
Cooperation	Cooperates with others (outside of the discipline)	Occasionally works as a loner or interacts to a minor extent with extra-disciplinary team members	Does not contribute to group work at all or submits own work as the group's
Credit Sharing	Shares credit for success with others and accountability for team results	Makes subtle references to other's poor performance or sometimes does not identify contributions of other team members	Claims work of group as own or frequently blames others
Information Sharing	Shares information with others and provides assistance to others	Sometimes keeps information to himself/herself; not very willing to share	Does work on his/her own; does not value team work
Designated Role Acceptance	Demonstrates the ability to assume a designated role in the group	Takes charge when not in the position to lead	Hides in the background; only participates if strongly encouraged. Does not willingly assume team roles
Valuation of Others' Ideas	Values alternative perspectives and encourages participation among all team members	Persuades others to adopt only his/her ideas or grudgingly accepts the ideas of others	Does not consider the ideas of others
Demeanor	Remains non-judgmental when disagreeing with others/seeking conflict resolution; does not "point fingers" or blame others when things go wrong	Sometimes criticizes ideas of other team members or blames others for errors	Is openly critical of the performance of others
Courtesy	Is courteous group member	Is not always considerate or courteous towards team members	Is discourteous to other group members
Knowledge of Other Disciplines	Has knowledge of technical skills, issues and approaches germane to disciplines outside of civil engineering	Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members	Has no knowledge of disciplines outside of civil engineering

Outcome 7 - Graduates will be able to identify, formulate and solve engineering problems at the interface of engineering and biology.

	Level 5	Level 3	Level 1
Creativity	Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information	Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated	Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems
Theory Connection to Practical Solution	Can relate theoretical concepts to practical problem solving	Connects theoretical concepts to practical problem-solving when prompted	Does not see the connection between theory and practical problem solving
Outcome Prediction and Defense	Can predict and defend problem outcomes	Occasionally predicts and defends problem outcomes	Is unable to predict or defend problem outcomes
Resources	Uses appropriate resources to locate information needed to solve problems	Uses limited resources to solve problems	Uses no resources to solve problems
Knowledge Integration	Takes new information and effectively integrates it with previous knowledge	Must be assisted in integrating previous knowledge and new information	Has no concept of how previous knowledge and new information relate
Component Relationship	Demonstrates understanding of how various pieces of the problem relate to each other and the whole	Is missing some of the pieces of the whole problem	Does not realize when major components of the problem are missing
Strategy	Formulates strategies for solving problems	Has some strategies for problem-solving, but does not apply them consistently	Has no coherent strategies for problem solving
Solution	The answer is correct and properly labeled	The answer is nearly correct, but properly labeled (within reasonable and logical range of the correct answer-it's in the "ballpark")	The answer is incorrect and not checked for its reasonableness
Validation	The solution is correct and checked in other ways when it can be; the interpretation is appropriate and makes sense	The solution is correct, but not checked in other ways	No attempt at checking the obviously incorrect solution--no commentary

Outcome 8 - Graduates will be able to use modern engineering tools for analysis, design and communication.

	Level 5	Level 3	Level 1
Tools	Uses computer-based and other resources effectively in assignments/projects	Needs some guidance in selecting appropriate equipment and instrumentation	Cannot select the appropriate equipment and instrumentation required to run the experiment(s)
Outside Resources	Seeks information on problems from multiple resources	Seeks information for experiment(s) from a few sources - mainly from the textbook or the instructor	Seeks no extra information for experiments other than what is provided by instructor
	Is able to interpret and understand information from a variety of resources	Is somewhat able to interpret and understand information from a variety of resources	Is not able to interpret and understand information from a variety of resources
Skill Maintenance	Maintains current, state-of-the-art abilities in PC use	Maintains some abilities in PC use	Lacks abilities in PC use
	Is able to learn and implement process simulation software	With extra instruction, can learn to use new or unfamiliar software	Cannot learn to use new or unfamiliar software
Traditional Resources	Understands the organization and use of the library		Does not understand the organization and use of the library

Outcome 9 - Graduates will understand professional and ethical responsibility.

	Level 5	Level 3	Level 1
Knowledge of Standardized Code of Ethics	Student understands and abides by the NSPE Code of Ethics and the UAB Students' Code of Conduct	Student is aware of the existence of the NSPE Code of Ethics and other bases for ethical behavior	Student is not aware of any codes for ethical behavior
Participation in Ethical Discussions	Participates in class discussions and exercises on ethics and professionalism	Does not take the discussion of ethics seriously but is willing to accept its existence	Does not participate in or contribute to discussions of ethics; does not accept the need for professional ethics
Behavior	Demonstrates ethical behavior among peers and faculty	Does not model ethical behavior among peers and faculty	Student has been caught cheating or plagiarizing the work of others
Responsibility	Takes personal responsibility for his/her actions	Doesn't recognize the need to take personal responsibility for his/her actions	Blames others for own issues and problems
Respect for Others	Is punctual, professional, and collegial; attends classes regularly	Sometimes exhibits unprofessional behavior; is sometimes absent from class without reason	Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty

Objectivity	Evaluates and judges a situation in practice or as a case study, using facts and a professional code of ethics	Evaluates and judges a situation in practice or as a case study using personal understanding of the situation, possibly applying a personal value system	Evaluates and judges a situation in practice or as a case study using a biased perspective without objectivity
Personal versus Professional Ethics	Uses personal value system to support actions, but understands the role of professional ethical standards for corporate decisions	Uses personal value system to support actions, but confuses personal ethics with professional ethics	Uses personal value system to support actions to the exclusion of all other ethical standards

Outcome 10a - Graduates will be able to communicate effectively in oral (10a) form.

	Level 5	Level 3	Level 1
Delivery	Plans and delivers an oral presentation effectively; applies the principle of "(tell them)" --well organized	Presents key elements of an oral presentation adequately, but "tell them" not clearly applied	Talk is poorly organized, e.g. no clear introduction or summary of talk is presented
Length and Detail	Presentation has enough detail appropriate and technical content for the time constraint and the audience	Presentation contains excessive or insufficient detail for time allowed or level of audience	Presentation is inappropriately short or excessively long; omits key results during presentation
Mechanics	Presents well mechanically Makes eye contact Can be easily heard Speaks comfortably with minimal prompts (notecards)Does not block screen No distracting nervous habits	Has some minor difficulties with the mechanical aspects of the presentation Eye contact is sporadic Occasionally difficult to hear or understand speaking Overuses prompts or does not use prompts enough-occasionally stumbles or loses place; appears to have memorized presentation Occasionally blocks screen Some nervous habits (um, ah, clicking pointer, etc.)	Major difficulties with the mechanical aspects of the presentation No eye contact Difficult to hear or understand speaking Reads from prepared script Blocks the screen Distracting nervous habits (um, ah, clicking pointer, etc.)
Dialect	Uses proper American English	Occasionally uses an inappropriate style of English-too conversational	Uses poor English
Visual Aides	Uses visual aides effectively	Visual aides have minor errors or are not always clearly visible	Multiple slides are unclear or incomprehensible
Appearance	Professional appearance	Appearance is too casual for the circumstances	Inappropriate attire, slovenly or too revealing
Listening and Response to Questions	Listens carefully and responds to questions appropriately; is able to explain and interpret results for various audiences and purposes	Sometimes misunderstands questions, does not respond appropriately to the audience, or has some trouble answering questions	Does not listen carefully to questions, does not provide an appropriate answer, or is unable to answer questions about presentation material

Outcome 10b - Graduates will be able to communicate effectively in written (10b) form

	Level 5	Level 3	Level 1
Articulation	Articulates ideas clearly and concisely	Articulates ideas, but writing is somewhat disjointed, superfluous or difficult to follow	Text rambles, points made are only understood with repeated reading, and key points are not organized
Organization	Organizes written materials in a logical sequence to enhance the reader's comprehension (paragraphs, subheading, etc.)	Material are generally organized well, but paragraphs combine multiple thoughts or sections and sub-sections are not identified clearly	Little or no structure or organization; no subheadings or proper paragraph structure used
Use of Supporting Graphs, Tables, etc	Uses graphs, tables, and diagrams to support points-to explain, interpret, and assess information	Uses graphs, tables, and diagrams, but only in a few instances are they applied to support, explain or interpret information	Graphs, tables or diagrams are used, but no reference is made to them
Neatness	Written work is presented neatly and professionally	Work is not neatly presented throughout	Work is not presented neatly
Grammar and Spelling	Grammar and spelling are correct	One or two spelling/grammar errors per page	Spelling/grammar errors present throughout more than 1/3 of the paper
Figure Formatting	Figures are all in proper format	Figures are present but are flawed-axes mislabeled, no data points, etc	No figures or graphics are used at all
Writing Style	Uses good professional writing style	Style is informal or inappropriate, jargon is used, improper voice, tense...	The writing style is inappropriate for the audience and for the assignment
Document Formatting	Conforms to the prescribed format (if any)	The prescribed format is only followed in some portions of the paper	The prescribed format is not followed

Outcome 11 - Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context

	Level 5	Level 3	Level 1
Current Events	Is familiar with the current trends in the biomedical engineering discipline	Is aware of current events in society	Is unaware of current events
Historical Aspects	Respects the historical aspects of engineering solutions and their impacts	Is aware of historical aspects of engineering solutions, but is not influenced by them	Is unaware of historical effect of engineering solutions
Technical Periodicals	Reads and is familiar with the content of periodicals that are relevant to understanding the global and societal impact of engineering	Is aware of the existence of technical periodicals - would know where to look to find them	Is not familiar with any technical periodicals
Valuation of Engineering Discipline	Has a personal perspective on the importance (or lack thereof) of engineering in today's world	Is interested in engineering because of what the discipline offers him/her personally	Isn't sure why he/she is studying engineering

Outcome 12 - Graduates will recognize the need for and be able to engage in life-long learning.

	Level 5	Level 3	Level 1
Initiative	Demonstrates ability to learn independently. Goes beyond what is required in completing an assignment.	Requires guidance as to expected outcome of task or project. Completes only what is required	Requires detailed or step-by-step instructions to complete a task
Development	Learns from mistakes and practices continuous improvement	Sometimes is able to avoid repeating the same mistakes	Is unable to recognize own shortcomings or deficiencies
Responsibility	Demonstrates responsibility for creating one's own learning opportunities.	Does not always take responsibility for own learning	Has trouble completing even the minimum required tasks
Outside Sources	Demonstrates capability to think for one's self. Brings information from outside sources into assignments	Seldom brings information from outside sources to assignments	Assumes that all learning takes place within the confines of the class. Shows little or no interest in outside learning resources.
Reasoning	Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class (e.g. different nomenclature, understand equation from different textbook)	Has some trouble using materials and concepts that are in a different format from that taught in class	Cannot use materials outside of what is explained in class
Professional and Technical Societies	Participates and takes a leadership role in professional and technical societies available to the student body	Occasionally participates in the activities of local professional and technical societies	Does not show any interest in professional and/or technical societies

Outcome 13 - Graduates will have knowledge of contemporary issues through integration of faculty experience gained from research and professional activities into program courses.

	Level 5	Level 3	Level 1
Current Events	Has knowledge of current events in the engineering discipline and in society	Has some knowledge of current events	Has no clue about issues and events in the world
Job Market	Has a good perspective on the current job market	Has a somewhat narrow perspective on the current job market	Hopes that a job will fall into his/her lap
Political Issues	Able to discuss in-depth major political issues at national, state and local levels. Can summarize essence of several issues; take and defend a position on them	Able to comment on major political issues, but is not familiar enough with them to defend a position on them. Can summarize the facts of the issues	Unable to comment on political solutions or is unaware of world and local happenings

Design Project Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student: _____ Reviewer: _____

Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Design Problem and Boundaries (1)	Little or no grasp of problem. Incapable of producing a successful solution.	Some understanding of problem. Major deficiencies that will impact the quality of solution.	Overall sound understanding of the problem and constraints. Does not significantly impair solution.	Clear and complete understanding of design goal and constraints.	
Alternative Designs (2)	Only one design presented or clearly infeasible alternative given.	Serious deficiencies in exploring and identifying alternative designs.	Alternative approaches identified to some degree.	Final design achieved after review of reasonable alternatives.	
Use of Computer-Aided Tools (2)	Serious deficiencies in understanding the correct selection and/or use of tools.	Minimal application and use of appropriate tools.	Computer-aided tools used with moderate effectiveness to develop designs.	Computer-aided tools are used effectively to develop and analyze designs.	
Application of Engineering Principles (2)	No or erroneous application of engineering principles yielding unreasonable solution.	Serious deficiencies in proper selection and use of engineering principles.	Effective application of engineering principles resulting in reasonable solution.	Critical selection and application of engineering principles ensuring reasonable results.	
Final Design (3)	Not capable of achieving desired objectives. No implementation of resource conservation and recycle strategies.	Barely capable of achieving desired objectives. Minimal utilization of resource conservation and recycle potentials.	Design meets desired objectives. Moderately effective utilization of resource conservation and recycle potentials.	Design meets or exceeds desired objectives. Effective implementation of resource conservation and recycle strategies.	
Process Economics (1)	No or totally erroneous cost estimates presented.	Reasonable cost estimates presented, but no profitability analysis included.	Reasonable profitability analysis presented, but no interpretation of the results.	Effective use of profitability analysis leading to improvement recommendations.	

Interpretation of Results (2)	No or erroneous conclusions based on achieved results.	Serious deficiencies in support for stated conclusions.	Sound conclusions reached based on achieved results.	Insightful, supported conclusions and recommendations	
OVERALL PERFORMANCE	θ Unacceptable	θ Marginal	θ Acceptable	θ Exceptional	TOTAL
POINTS REQUIRED	0–9	10–19	20–29	30–39	

Ethics, Safety, Society, Environment Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student: _____ Reviewer: _____

Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Professional Integrity & Ethical Decision Making (1)	No evidence of any appreciation and/or understanding of professional integrity and/or ethics. Incapable of answering any questions on the subject.	Serious deficiencies in appreciation and/or understanding of professional integrity and/or ethics. Only rudimentary questions are answered. Not able to elaborate or explain.	Sound understanding of and mostly effective in addressing issues related to integrity and ethics. Most decisions and recommendations are supported and can be justified. Some elaboration and explanations given.	Clear and complete understanding of and effective in addressing issues related to integrity and ethics. Decisions and recommendations are supported and discussed along with elaboration and explanation.	
Safety & Health Issues (1)	No understanding or appreciation of safety and health related issues.	Serious deficiencies in addressing health and safety issues leading to a unsupported and/or infeasible result.	Sound understanding of health and safety issues. Mostly effective in achieving supported results.	Complete understanding of health and safety issues leading to sound and supported results.	
Environmental Aspects (1)	No understanding or appreciation of the importance of environmental concerns.	Environmental aspects are addressed ineffectively with little or no effect on end results.	Sound understanding of environmental aspects. Mostly effective in addressing environmental issues.	Complete understanding of environmental aspects. Effective in addressing of environmental issues leading to a better result.	
Public Interest & Societal Impact (1)	No consideration of public interest or societal impact. None or erroneous evaluation of global effects of engineering project/product.	Serious deficiencies in understanding public interest and/or societal impact. Ineffective evaluation of impact of engineering project/product	Sound understanding of public interest and societal impact. Mostly effective evaluation of engineering project/product impact leads to improved results.	Complete understanding of public interest and societal impact. Effective assessment of engineering project/product impact support and explain	

		adversely affects result.		results.	
OVERALL PERFORMANCE	⊖ Unacceptable	⊖ Marginal	⊖ Acceptable	⊖ Exceptional	TOTAL
POINTS REQUIRED	0–3	4–6	7–9	10–12	

Oral Communications Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student: _____ Reviewer: _____

Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Organization & Structure (1)	Not possible to understand presentation due to absence of structure.	Difficult to follow presentation due to erratic topical shifts and jumps.	Most information is presented in logical order which is easy to follow.	All information is presented in a logical, interesting and novel sequence, which is easily followed.	
Content & Knowledge (3)	No grasp of information. Unable to answer questions about subject.	Uncomfortable with information. Capable only of answering rudimentary questions.	At ease with content and able to elaborate and explain to some degree.	Demonstration of full knowledge of the subject with explanations and elaboration.	
Visual Aids & Neatness (2)	No visual aids.	Occasional use of visual aids, however they barely support text or presentation. Several misspellings and/or grammatical errors on slides.	Visual aids are related to text and presentation. Minor misspellings and/or grammatical errors.	Text and presentation are reinforced by the use of visual aids. Negligible misspellings and/or grammatical errors.	
Delivery & Speaking Skills (2)	Significant mumbling and incorrect pronunciation of terms. Voice level too low or too high. Monotonous, no eye contact, rate of speech too fast or too slow	Occasional mispronunciation of terms. Little eye contact, uneven rate, only little expression	Voice is clear and at a proper level. Most words pronounced correctly. Some eye contact, steady rate, excessively rehearsed	Clear voice and correct, precise pronunciation of terms. Good eye contact, steady rate, enthusiasm, confidence	
Presentation Length (1)	Too long or too short. +/- 10 minutes	+/- 6 minutes	+/- 4 minutes	+/- 2 minutes	

OVERALL PERFORMANCE	θ Unacceptable	θ Marginal	θ Acceptable	θ Exceptional	TOTAL
POINTS REQUIRED	0-6	7-13	14-20	21-27	

Data Analysis / Experimental Design Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student: _____ Reviewer: _____

Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Effectiveness of Experimental Design and/or Procedures (2)	Very ineffective. Would not allow experimenters to achieve any goals.	Somewhat ineffective. Would allow experimenter(s) to achieve some goals.	Somewhat effective. Would allow experimenter(s) to achieve most goals.	Effective. Would allow experimenter(s) to achieve all goals.	
Execution of Procedures (1)	Demonstrated little or no ability to conduct experiments. Did not collect meaningful data.	Demonstrated some ability to conduct experiments. Collected some meaningful data.	Demonstrated adequate ability to conduct experiments. Collected most of the needed data.	Demonstrated superior ability to conduct experiments. Collected all the appropriate data.	
Statistical Methods: Error Analysis, Regression, ANOVA (2)	Statistical methods were completely misapplied or absent.	Statistical methods were attempted. Some methods were applied but with significant errors or omissions.	Statistical methods were attempted. Most methods were correctly applied but more could have been done with the data.	Statistical methods were fully and correctly applied.	
Focus of Results and Discussion (1)	No insight. Entirely missed the point of the experiment.	Little insight. Analyzed only the most basic points.	Adequate insight. Missed some important points.	Excellent insight. Results and discussion well focused.	
Interpretation of Data (2)	Little or no attempt to interpret data or over-interpreted data.	Interpreted some data correctly. Significant errors, omissions, or over-interpreted data.	Interpreted most data correctly. Some conclusions may be suspect or over-interpreted.	Data completely and appropriately interpreted. Not over-interpreted.	
OVERALL PERFORMANCE	\emptyset Unacceptable	\emptyset Marginal	\emptyset Acceptable	\emptyset Exceptional	TOTAL
POINTS REQUIRED	0–6	7–12	13–18	19–24	

Written Communication Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student _____ Reviewer: _____
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Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Organization & Style (2)	Sequence of information is difficult to follow. No apparent structure or continuity. Purpose of work is not clearly stated.	Work is hard to follow as there is very little continuity. Purpose of work is stated, but does not assist in following work.	Information is presented in a logical manner, which is easily followed. Purpose of work is clearly stated and assists the structure of work.	Information is presented in a logical, interesting way, which is easy to follow. Purpose is clearly stated and explains the structure of work.	
Content & Knowledge (3)	No grasp of information. Clearly no knowledge of subject matter. No questions are answered. No interpretation made.	Uncomfortable with content. Only basic concepts are demonstrated and interpreted.	At ease with content and able to elaborate and explain to some degree.	Demonstration of full knowledge of the subject with explanations and elaboration.	
Format & Aesthetics (1)	Work is illegible, format changes throughout, e.g. font type, size etc. Figures and tables are sloppy and fail to provide intended information.	Mostly consistent format. Figures and tables are legible, but not convincing.	Format is generally consistent including heading styles and captions. Figures and tables are neatly done and provide intended information.	Format is consistent throughout including heading styles and captions. Figures and tables are presented logically and reinforce the text.	
Spelling & Grammar (1)	Numerous spelling and grammatical errors.	Several spelling and grammatical errors.	Minor misspellings and/or grammatical errors.	Negligible misspellings and/or grammatical errors.	
References (2)	No referencing system used.	Inadequate list of references or references in text. Inconsistent or illogical referencing system.	Minor inadequacies in references. Consistent referencing system.	Reference section complete and comprehensive. Consistent and logical referencing system.	

OVERALL PERFORMANCE	⊖ Unacceptable	⊖ Marginal	⊖ Acceptable	⊖ Exceptional	TOTAL
POINTS REQUIRED	0-6	7-13	14-20	21-27	

Other Work Skills Assessment Rubric—Auburn University Dept. of Chemical Engineering, downloaded January 30, 2006 from <http://www.eng.auburn.edu/programs/chen/programs/accreditation/assessment-rubrics.html>

Course No.: _____ Date: _____
 Team/Student: _____ Reviewer: _____

Topic (Weight)	Unacceptable (0)	Marginal (1)	Acceptable (2)	Exceptional (3)	Points
Need for Life-Long Learning (1)	<p>Little or no awareness and/or use of external sources of information.</p> <p>Little or no initiative to explore new learning opportunities. Unwilling to take risks by undertaking challenging or unfamiliar assignments, e.g. no initiative to learn new software.</p>	<p>Some evidence of efforts to locate and use external resources.</p> <p>Some willingness to participate in learning activities and take risks. Some ability to use library/internet sources and e.g. new software packages.</p>	<p>Reasonable awareness and use of external resources.</p> <p>Reasonable willingness to participate in learning activities and take risks. Adequate ability to locate and use library and Internet resources. Shows reasonable attempt to, e.g. learn new software packages.</p>	<p>Fully aware of external sources of material. Effective use of supplementary resources.</p> <p>Actively seeks learning opportunities (reading, self-study, extra-curricular activities). Excellent ability to locate and use library and Internet resources. Seeks opportunities to learn new material, e.g. software packages.</p>	
Teamwork (1)	<p>Little or no distribution of work efforts and responsibilities.</p> <p>Little or no ability to work together in a professional and productive manner adversely affecting end result.</p>	<p>Minimal organization and planning with limited contributions of most team members.</p> <p>Significant deficiencies in leadership, cooperation and/or interaction. End result may suffer to some degree.</p>	<p>Adequate organization and planning with contributions from all members of the team.</p> <p>Some leadership, planning and interaction is evident.</p>	<p>Great organization and planning with full participation and technical contributions from all members.</p> <p>Utilizes technical strengths of each team member to full advantage leading to productive interaction.</p>	
OVERALL PERFORMANCE	⊖ Unacceptable	⊖ Marginal	⊖ Acceptable	⊖ Exceptional	TOTAL
POINTS REQUIRED	0-1	2-3	4-5	6	

Rubric for Evaluation of Lab Exercise—CSU Chico, downloaded January 30, 2006
 from <http://www.engr.sjsu.edu/assessment/topic/rubricLab.htm>

Attribute	1 - Not Acceptable	2 - Below Expectations	3 - Meets Expectations	4 - Exceeds Expectations	Score
Equipment use					
Understanding of equipment operation and limitations	Equipment used in a fundamentally wrong manner	Some conceptual errors in usage of equipment	Equipment used properly	Innovative and proper usage of equipment	
Usage of equipment in a manner that does not endanger it or circuits connected to it	Damage to circuits or equipment due to improper usage	Some risk to circuits or equipment due to improper usage	Equipment usage safe for both circuits and equipment	Safety precautions above requirements used	
Setup of circuit and equipment	Apparatus set up in a non-functional manner	Apparatus set up will cause data errors	Apparatus properly set up	Apparatus enhanced for better precision	
Lab report					
Reports detailed enough to allow duplication of results by another	Errors in documentation of apparatus	Error in documentation of procedures	Documentation complete and correct	Report warns of difficulties and gives alternatives	
Reports logically coherent and sequential	Conditions for data and/or graphs not stated. Unclear report	All data present, but not in sequence. Must search for items	Data presented clearly following each procedure	Data presented clearly along with excellent narrative	
Reports include all required data	Required data not taken or not reported	Data points poorly chosen or missing	All required data taken and reported	Measurements beyond requirements made and reported	
Critical evaluation of findings	Blind acceptance of clearly defective results	Recognizes defective results but does not know what to do	Recognizes defective results and figures out the cause	Recognizes defective results and eliminates the cause	
Correct data reduction	Data not reduced	Data reduced improperly or incompletely	Data reduced correctly	Extra data taken and reduced correctly	
Ability to recognize main sources of error	Not understood	Errors in understanding	Clear understanding		
Correlation between data and theory	Not done	Done poorly or incompletely	Complete and done well	Qualitative accounting for	

				differences	
Ability to draw proper conclusions from lab	Conclusions not drawn	Incorrect conclusions drawn	Correct conclusions drawn	Correct conclusions cor-related to other material	
Spelling and grammar	Many errors	Several errors	No more than two errors	No errors	
Computer use					
For data analysis	Not done	Done incorrectly	Done correctly and completely		
For data presentation	Not done	Done incorrectly	Done correctly and completely		
For locating resources that lab may require	Not done	Done incorrectly	Done correctly and completely		

Rubric for Oral Report—CSU Chico, downloaded January 30, 2006 from <http://www.engr.sjsu.edu/assessment/topic/rubricOral.htm>

Attribute	1 - Not Acceptable	2 - Below Expectations	3 - Meets Expectations	4 - Exceeds Expectations	Score
Effective use of Visual Aids (VA)					
Clarity and readability of overheads	not clear or unreadable	difficult to read	clear and readable	superior clarity and readability	
Use of space on VA	VA unreadable because too crowded	too little or too much information of VA	appropriate amount of information on VA	VAs very well designed	
Lettering readable	font unreadable	font too small	font readable		
Color, over- or under-use (if used)	colors too hard to distinguish, colors do not project well	poor choice and use of colors	primary/easily distinguishable colors	use of color enhances clarity of presentation	
Wording concise	slides full of text	slides too wordy	slides appropriate		
Appropriate amount of information per VA	so much or so little information per VA to make VA useless	too much information per VA, missing information such as labels on axis	appropriate level of information per slide		
Effective use of Software to prepare visual aids	sloppy, format for graphs not followed	poor, some format errors	appropriate, all formats followed	superior clarity, all formats followed	
Presentation organization					
Logical order of topics	totally disjointed, no organization	some items presented out of order	organization as per guidelines	superior organization enhances communication	
Appropriate use of time: Not too long /short	far too long or far too short	somewhat too long or too short	appropriate length		
Complete "story" told	story missing, no story told	story incomplete	complete story told		
Introduction and overview: Problem stated	problem not stated,	problem poorly stated	problem clearly stated	problem clearly stated, good perspective on problem shown	
Constraints and assumptions explained	missing constraints or assumptions	some constants or assumptions	constraints and assumptions	constraints and assumptions	

		not stated	stated	clearly stated and explained	
Methodology or approach: coverage appropriate (if applicable)	methodology not explained	methodology unclear	methodology clear	theoretical development methodology so clear as not to require questioning	
Problem solution	problem not solved or solution not explained	problem solution fuzzy	most of problem solution explained	problem solution superior or beyond expectations	
Conclusions/Recommendations: Significance explained	inadequate conclusions or recommendations, or conclusion and recommendations not based on facts presented	present, but not logical, significance not explained	present, logical, significance clearly explained	present, logical, superior explanations of significance and relevance	
Group Presentation (if applicable)					
Even division of effort	one person clearly dominates or did not contribute	apparent uneven distribution of effort	even division of effort	each member made a significant contribution	
Interaction between team members	it is clear that solution did not result from good team interaction	poor interaction between team members apparent	good teamwork	clearly team functioned well, product clearly exceeds sum of parts	
All members of group understand solution	clearly at least one member unaware of solution/strategy	unclear that all members understand solution and methodology	all members understand complete solution and methodology	all members understand solution, what they did, and what team members did	
Presentation Mechanics					
Voice volume, enunciation, speed	unintelligible or had to	voice hard to hear, words slurred or voice trails off, spoke too slow or too fast, monotone with little emphasis	voice clearly heard, words clearly enunciated, did not speak too slowly or too rapidly	voice projected very well, clear enunciation, did not speak too slowly or rapidly	
Hesitations, other voice habits	presentation full of hesitations, ums, ahs, etc.	some hesitations, ums, ahs, etc.	clear, continuous presentation,	superior presentation, free of ums,	

			perhaps a few ums, ahs, etc.	ahs, etc.	
Distracting mannerisms	presentation full of distracting mannerisms such as giggling	some distracting mannerisms	no distracting mannerisms	superior presentation	
Maintaining eye contact	no eye contact at all	poor eye contact & endash; looking down or at screen significant portion of time	maintained eye contact other than quick glances at screen	maintained eye contact with all segments of the audience	
Poise	clearly unsure, nervous, confused	at times appears unsure, nervous, confused	composed at all times	exudes/convey confidence	
Body language	immobile, hands in pockets, or blocked screen	didn't always indicate how material on VA was related to presentation	consistently used gestures to coordinate oral and visual presentation	excellent use gestures to provide emphasis	
Response to Questions					
Direct / evasive	non-responsive	evasive or inaccurate	clear and direct	very clear and complete	
Complete	nonexistent	incomplete	complete	complete and enhancing result and communication	
Appropriate participation (for groups/if applicable)	clearly at least one member unable to respond	not all members participate appropriately	all members participate appropriately	all members can answer questions on all aspects of presentation	

Rubric for Senior Project—CSU Chico, downloaded January 30, 2006 from <http://www.engr.sjsu.edu/assessment/topic/rubricSrProj.htm>

Attribute	1-Not acceptable	2-Below expectations	3-Meets expectations	4-Exceeds expectations	Score
Concept					
Executive summary	missing, contains no useful information, or is too long	not written for correct audience or some information missing	information is complete and appropriate for executives	complete, consistent and gives an thorough overview of the project	
User definition	missing	too generic	precise description of intended users		
Environmental and social impact	missing or bears little resemblance to reality	one component is poorly presented	adequate description of both aspects	superior analysis of impact with justification	
Assumptions, dependencies and constraints	missing or misplaced	one component is poorly presented	all know items are listed and explained	shows insight into problem and outside forces	
User accessible features	missing or incomplete list, not defined from user perspective or not verifiable	some feature are ambiguous or wordy	all features listed are clear, complete and verifiable	gives complete and concise description of of everything needed	
Cost estimate	missing, not based on facts, or too high level	looks like a guess	addresses each subsystem		
Glossary	missing	some terms and definitions unclear	all nonstandard terms and acronyms used are clearly defined		
Appendices, if appropriate	critical information missing	poor organization or references not cited	all referenced material present and readable	organization and placement of material improved readability	
Requirements					
Introduction	missing or failed to describe project	too long or short, or not written for correct audience	complete overview	superior style and readability	
Features and functions	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements	

				clear	
User interface requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
External interface requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
Installation requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
Test requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
Packaging requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
Environmental and power requirements	unclear, ambiguous, or not testable	not written for technical audience or includes design	complete, consistent and unambiguous	style and wording make all requirements clear	
Design constraints	unclear, ambiguous, or not testable	not written for technical audience	complete, consistent and unambiguous	style and wording make all requirements clear	
References and standards	some references not cited or standards omitted	references not specific	all appropriate references and standards listed	quality of references show superior insight	
Glossary	missing	some terms and definitions unclear	all nonstandard terms and acronyms used are clearly defined		
Appendices, if appropriate	critical information missing	poor organization or references not cited	all referenced material present and readable	organization and placement of material improved readability	
Schedule					

Task list	missing	too much or too little detail	all relevant tasks listed		
Initial completion dates	missing or incorrect	some date unrealistic	all dates are reasonable		
Current estimated completion dates, if applicable	missing or incorrect	some date unrealistic	all dates are reasonable		
Actual completion dates, if applicable	missing or incorrect		all dates are correct		
Architectural Design					
Hardware elements, if appropriate	missing or incorrect	too much or too little detail	all relevant elements listed	design is simple, yet elegant and complete	
Software elements, if appropriate	missing or incorrect	too much or too little detail	all relevant elements listed	design is simple, yet elegant and complete	
Interfaces	missing or incorrect	not clearly defined	all interfaces shown	descriptions clarify the design	
Hardware Design					
State diagrams, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Schematics, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Timing diagrams, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Theory of operation	missing or inaccurate	some concepts or elements are poorly explained	all explanations are complete and readable	superior optimization and wording makes design clear	
Design constraints, if applicable	missing or no rationale given	poor justification for constraint	clearly stated and reasonable		
Tradeoffs	missing	reason for choice not clear	logical reasoning used to make tradeoff	proof presented to validate tradeoff	
External interfaces	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Software Design					

Static design, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Functional design, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Dynamic design, if applicable	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Theory of operation	missing or inaccurate	come concepts or elements are poorly explained	all explanations are complete and readable	superior optimization and wording makes design clear	
Design constraints, if applicable	missing or no rationale given	poor justification for constraint	clearly stated and reasonable		
Tradeoffs	missing	reason for choice not clear	logical reasoning used to make tradeoff	proof presented to validate tradeoff	
External interfaces	missing or incorrect	hard to read, or missing some information	readable, complete and correct	superior organization and readability	
Test Plan					
Features and other requirements	items missing		all requirements listed		
Equipment needed	undefined		list complete		
Inputs	undefined or no tolerances given		accurate description of inputs and tolerances		
Outputs	undefined or no pass/fail criteria given		expected outputs and pass/fail criteria listed		
Procedure	missing or unclear	not enough detail or too much detail given	accurate description of how test must be conducted	superior explanation makes testing easy	
Status Reports					
Current Phase	missing or unclear	too wordy or too short	complete description of current phase and tasks	superior description gives concise description of progress	
Completed Tasks	missing or incomplete	errors in dates	complete and correct		

Issues	missing	poor explanation of the problem	clear explanation of all potential problems	superior analysis of possible solutions to problems	
Next Tasks	missing or incomplete	unrealistic completion dates	complete with reasonable dates	superior justification given for completion dates	
Implementation					
Parts list, if applicable	missing or incomplete	uses computer, but contains errors	use of computer to obtain correct/valid results	superior use of computer to obtain unique solution	
Wiring diagrams, if applicable	missing or incomplete	uses computer, but contains errors	use of computer to obtain correct/valid information	superior use of computer to obtain unique solution	
Hardware equipment tool summary, if applicable	missing or incomplete	only generic descriptions	complete list of all equipment and tools used		
Documented code, if applicable	missing or incomplete	some department coding standards not met	follows all department coding standards	superior use of style and comments	
Software tool summary, if applicable	missing or incomplete	only generic descriptions	complete list of all tools used		
Delivery					
Presentation	not understandable	too short or too long	described all important features of project	interesting and exciting presentation	
Demonstration	did not work successfully	some parts of project were not working	demonstrated all features required for project	went way beyond what was required for project	
Documentation	elements missing	poorly organized, hard to find key elements, or missing draft versions of documents	project summary and all documents included	superior summary, and excellent organization and appearance	

Rubric for Evaluating Written Report—CSU Chico, downloaded January 30, 2006
 from <http://www.engr.sjsu.edu/assessment/topic/rubricWritten.htm>

Attribute	1-Not acceptable	2-Below expectations	3-Meets expectations	4-Exceeds expectations	Score
Report Mechanics					
Organization	inappropriate content of several sections of report	some content placed incorrectly in report	content appropriate to all section of report	excellent organization enhances readability and/or understandability of report	
Complete Story Told	story told is incomplete	a few aspects of story missing	story told is complete	material added enhances quality of story told	
Aesthetics	unacceptable appearance e.g., tables and figures cannot be read or understood, fonts difficult to read; style unclear	some portions are sloppy and difficult to read; style needs improvement	text, tables, figures readable and understandable; style is acceptable	text, tables, figures so clear and understandable as to enhance report impact; style enhances readability	
Format	so many format errors as to make report ineffective	a few format errors	followed specified format	unique format aspects that enhance report impact	
Spelling	any spelling errors	only spelling errors are different spellings for same pronunciation	no spelling errors		
Grammar and Punctuation	pages or paragraphs with multiple grammar and punctuation errors	a few significant grammar and punctuation errors	minor grammar or punctuation errors	no grammar or punctuation errors	
Length	more than 20% too long or too short	10% to 20% too long or too short	length is appropriate		
Content					
Cover Memo problem stated, conclusion summarized	not present	simply says "here it is"	includes key results and recommendations	so clear and complete as to enhance impact of report	
Abstract/Executive	problem not	problem stated	problem clearly	so clear and	

Summary problem stated, conclusion summarized	stated, conclusion not summarized, only stated what did; not written for appropriate audience	somewhat, significant results not included; some material not appropriate for intended audience	stated, key results clearly stated; easily understood by intended audience	complete as to enhance impact of report	
Introduction problem stated, constraints explained	problem not stated, constraints not explained, assumptions not listed, contains results/conclusions	problem stated, perhaps poorly, no or limited discussion of constraints and assumptions	problem clearly stated, constraints and assumptions clearly listed	so clear and complete as to enhance impact of report	
Requirements user needs or product technical requirements	many ambiguous statements, incomplete or inconsistent set of requirement, or poorly written statements	some ambiguous statements, some wording could be improved	all requirements clearly stated	so clear and complete as to eliminate any questions about what is required	
Design hardware and software	unclear or major portions omitted	some ideas not well explained, but all topics addressed	clear and complete	so simple and clear the design is understandable to all intended readers	
User instructions commands and responses	instructions are inadequate for the typical user	unclear explanations, for design report, few optimizations	clear, for design report, optimizations presented and explained	so clear and complete as to enhance impact of report	
Theory of operation appropriate detail	missing, incomplete or incorrect description	users may have a few questions or have to reread material	instructions are complete and clear	so clear and complete as to enhance impact of report	
Results- presented, methodology clear, problem solved	missing or inaccurate results	unclear or incomplete	clearly stated results	so clear and complete as to enhance impact of report	
Conclusions/Recommendations present, significance explained, no new ideas	not stated, includes ideas not already discussed in report	includes ideas not already discussed in report, some recommendations not supported in document	clear, clearly follow report discussion, meaningful recommendations	so clear and complete as to enhance impact of report	

References provided as appropriate	incorrect format, not cited in report		correct format, all cited in report		
Appendix	appendix does not contain material cited in report	appropriate locations, appendix not clear and easy to follow	appropriate locations, appendix indexed, clear and easy to follow	so clear and complete as to enhance impact of report	
Effective use of Software to prepare written report	sloppy, format for graphs and figures not followed	poor, some format errors	appropriate, all formats followed	superior clarity, all formats followed	

ABET Scoring Rubrics—University of Delaware Dept. of Civil and Environmental Engineering, downloaded January 30, 2006 from http://www.ce.udel.edu/ABET/Current%20Documentation/ABET_scoring_rubrics_index.html

Outcome 1: An ability to apply math & science in engineering

Level 5 performance characterized by:

- Combines mathematical and/or scientific principles to formulate models of chemical, physical and/or biological processes and systems relevant to civil engineering
- Applies concepts of integral and differential calculus and/or linear algebra to solve civil engineering problems
- Shows appropriate engineering interpretation of mathematical and scientific terms
- Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality
- Executes calculations correctly
 - By hand
 - Using mathematical software
- Correctly analyzes data sets using statistical concepts

Level 3 performance characterized by:

- Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development
- Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving
- Most mathematical terms are interpreted correctly
- Some gaps in understanding the application of theory to the problem and expects theory to predict reality
- Minor errors in calculations
 - By hand
 - Applying math software
- Minor errors in statistical analysis of data

Level 1 performance characterized by:

- Does not understand the connection between mathematical models and chemical, physical, and/or biological processes and systems in civil engineering
- Does not understand the application of calculus and linear algebra in solving civil engineering problems
- Mathematical terms are interpreted incorrectly or not at all
- Does not appear to grasp the connection between theory and the problem
- Calculations not performed or performed incorrectly
 - By hand
 - Does not know how to use math software
- No application of statistics to analysis of data

Outcome 2: An ability to identify, formulate, and solve engineering problems

Level 5 performance characterized by:

- Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information
- Can relate theoretical concepts to practical problem solving
- Can predict and defend problem outcomes
- Uses appropriate resources to locate information needed to solve problems
- Takes new information and effectively integrates it with previous knowledge
- Demonstrates understanding of how various pieces of the problem relate to each other and the whole
- Formulates strategies for solving problems
- The answer is correct and properly labeled
- The solution is correct and checked in other ways when it can be; the interpretation is appropriate and makes sense

Level 3 performance characterized by:

- Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated
- Connects theoretical concepts to practical problem-solving when prompted
- Occasionally predicts and defends problem outcomes
- Uses limited resources to solve problems
- Must be assisted in integrating previous knowledge and new information
- Is missing some of the pieces of the whole problem
- Has some strategies for problem-solving, but does not apply them consistently
- The answer is nearly correct, but properly labeled (within reasonable and logical range of the correct answer-it's in the "ballpark")
- The solution is correct, but not checked in other ways

Level 1 performance characterized by:

- Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems
- Does not see the connection between theory and practical problem solving
- Is unable to predict or defend problem outcomes
- Uses no resources to solve problems
- Has no concept of how previous knowledge and new information relate
- Does not realize when major components of the problem are missing
- Has no coherent strategies for problem solving
- The answer is incorrect and not checked for its reasonableness
- No attempt at checking the obviously incorrect solution--no commentary

Outcome 3: An ability to design and conduct experiments, analyze and interpret data

Level 5 performance characterized by:

- Observes good laboratory safety procedures
- Formulates an experimental plan of data gathering to attain a stated objective (develop correlation, test a model, ascertain performance of equipment, etc.)
- Carefully documents data collected
- Develops and implements logical experimental procedures
- Can select appropriate equipment and instruments to perform the experiment
- Is able to operate instrumentation and process equipment

- Analyzes and interprets data carefully using appropriate theory; if required, translates theory into practice or applies to process model(s)
- Is aware of measurement error and is able to account for it statistically
- Seeks information for experiment(s) from multiple sources

Level 3 performance characterized by:

- Unsafe lab procedures observed infrequently
- Develops a simplistic experimental plan of data gathering, does not recognize entire scope of study (e.g. not all parameters affecting the results are investigated)
- Data collected are not all documented, units are missing, or some measurements are not recorded
Experimental procedures most often followed, but occasional oversight leads to loss of experimental efficiency and/or loss of data
- Needs some guidance in selecting appropriate equipment and instrumentation
- Is tentative in operation of instruments and process equipment
Applies appropriate theory to data when prompted to do so, but misinterprets physical significance of theory or variable involved; makes errors in unit conversions
- Is aware of measurement error but does not account for it statistically or does so at a minimal level
- Seeks information for experiment(s) from a few sources - mainly from the textbook or the instructor

Level 1 performance characterized by:

- Practices unsafe, risky behaviors in lab
- No systematic plan of data gathering; experimental data collection is disorganized, even random, and incomplete
- Data are poorly documented
- Does not follow experimental procedure
- Cannot select the appropriate equipment and instrumentation required to run the experiment(s)
- Does not operate instrumentation and process equipment, does so incorrectly or requires frequent supervision
- Makes no attempt to relate data to theory
- Is unaware of measurement error
- Seeks no extra information for experiments other than what is provided by instructor

Outcome 4: An ability to design and conduct experiments, analyze and interpret data

Level 5 performance characterized by:

- Uses computer-based and other resources effectively in assignments/projects
- Seeks information on problems from multiple resources
- Is able to interpret and understand information from a variety of resources
- Maintains current, state-of-the-art abilities in PC use
- Is able to learn and implement process simulation software
- Understand the organization and use of the library

Level 3 performance characterized by:

- Unsafe lab procedures observed infrequently

- Develops a simplistic experimental plan of data gathering, does not recognize entire scope of study (e.g. not all parameters affecting the results are investigated)
- Data collected are not all documented, units are missing, or some measurements are not recorded
Experimental procedures most often followed, but occasional oversight leads to loss of experimental efficiency and/or loss of data
- Needs some guidance in selecting appropriate equipment and instrumentation
- Is tentative in operation of instruments and process equipment
Applies appropriate theory to data when prompted to do so, but misinterprets physical significance of theory or variable involved; makes errors in unit conversions
- Is aware of measurement error but does not account for it statistically or does so at a minimal level
- Seeks information for experiment(s) from a few sources - mainly from the textbook or the instructor

Level 1 performance characterized by:

- Practices unsafe, risky behaviors in lab
- No systematic plan of data gathering; experimental data collection is disorganized, even random, and incomplete
- Data are poorly documented
- Does not follow experimental procedure
- Cannot select the appropriate equipment and instrumentation required to run the experiment(s)
- Does not operate instrumentation and process equipment, does so incorrectly or requires frequent supervision
- Makes no attempt to relate data to theory
- Is unaware of measurement error
- Seeks no extra information for experiments other than what is provided by instructor

Outcome 5: An ability to design a system, component or process

Level 5 performance characterized by:

- Develops a design strategy, including a plan of attack, decomposition of work into subtasks, development of a timetable
- Suggests new approaches and improves on what has been done before
- Develops several potential solutions and finds optimum
- Understands how areas interrelate and demonstrates ability to integrate prior knowledge into a new problem
Thinks holistically: sees the whole as well as the parts
- Uses computer tools and engineering resources effectively
- Supports design procedure with documentation and references
- Develops a solution that includes economic, safety, environmental and other realistic constraints
- Applies engineering and/or scientific principles correctly to design practical processes
- Recognizes practical significance of design outcome/answer (i.e. no outrageously sized reactors, 600 m towers, or pipes 1 mile in diameter!)

Level 3 performance characterized by:

- Uses a design strategy with guidance
- Can follow a previous example competently
- Can develop and compare multiple solutions to a problem, but does not usually arrive at the best result; conducts optimization but neglects one or two key aspects
- Can use prior knowledge to design individual pieces of equipment competently when guided to do so
- Does not think holistically: does not see the integration of the pieces clearly
- Minimal or incorrect use of computer tools and engineering resources
- Design is done, but procedures and equations are not documented or referenced
- Includes only minor or cursory consideration of economic, safety, and environmental constraints
- Applies engineering and/or scientific principles incompletely or incorrectly to design a practical process
- Gives an answer, but does not check its practicality

Level 1 performance characterized by:

- No design strategy; haphazard approach
- Cannot design processes or individual pieces of equipment without significant amounts of help
- Only focuses on one solution to a problem; no optimization attempted
- Unable to relate prior knowledge to the design problem
- Has no concept of the process as a sum of its parts
- No use of computer tools and engineering resources
- Design is done incompletely without the proper equations and without references
- No consideration of economics, safety, and environment
- No application of engineering and/or scientific principles
- Design is incomplete, no answer is given

Outcome 6: Ability to perform civil engineering design by means of problem-based experiences integrated throughout the curriculum**Level 5 performance characterized by:**

- Fully capable of conceiving, inventing, or contriving a scheme for turning a plan specification into an operational design producing structural alternatives that can be justified in terms of efficiency, flexibility, use and reuse and other factors. The schemes can encompass the design of such infrastructural elements as roads, buildings, airports, tunnels, dams, bridges, water supply, sewage systems, etc.
- Fully capable of integrating engineering, computer, and mathematical principles to resolve all the constraints involved in the design process to take into account economic, health, safety, social and environmental factors, codes of practice and applicable laws.
- Complete ability to produce a reasonable number of design alternatives knowing the pros and cons and advantages and disadvantages of each alternative. Completely confident about defending the various alternative designs in a public arena.

Level 3 performance characterized by:

- Has ideas about transforming plans into design alternatives including the justification of each alternative for use and reuse, efficiency, flexibility, and other factors.
- Aware of how engineering, computer, and mathematical principles should be used in developing alternative designs taking into consideration economic, health, safety, social, and environmental issues, codes of practice, and applicable laws.
- Aware of the advantages and disadvantages of each alternative design and may be able to defend the various alternatives in an appropriate public setting.

Level 1 performance characterized by:

- Unable to use existing plans to come up with a viable design.
- Unaware of how engineering, computer, and mathematical techniques are used for developing alternative designs.
- Does not understand the importance of having alternative design schemes for a single project.
- Is unable to defend the design team's alternatives in a public setting.

Outcome 7: Knowledge of professional practice issues, such as procurement of work, bidding versus quality-based selection processes, and the interactions of design and construction professionals in executing a project.

Level 5 performance characterized by:

- Fully aware that the forces driving modern civil engineering go beyond bringing new technologies to bear to meet societal needs. Knows that professional practice issues are dramatically reshaping when, where and how civil engineers do their jobs; the visibility and scope of the profession; and how civil engineers are compensated for their contributions.
- Fully capable of conducting the analysis for buying, purchasing, renting, leasing, or otherwise acquiring any materials, services or construction including all functions that pertain to the obtaining of any material, service or construction, such as description of requirements, selection and solicitation of sources, preparation and award of contract and all phases of contract administration.
- Fully capable of conducting a formal and competitive procurement procedure through which offers are requested, received, and evaluated for the procurement of goods, works, and services and as a consequence of which an award is made to the bidder whose offer is the most advantageous.
- Completely aware of the short-term cost vs. the long-term value of a project including consideration of immediate financial parameters as opposed to innovative solutions that may make a project more cost-effective in the long term.
- Recognizes the role of project leadership and the value of teamwork to project success, understands the team-building process and how to apply team-building techniques to managing projects, including team charter development, dispute resolution, expectations matrix, roles/responsibilities matrix, and recognitions/awards.

Level 3 performance characterized by:

- Knows about some of the professional practice issues that influence the practice of civil engineering.
- Knows about the procurement process in construction but may or may not be able fully conduct one.

- Is aware of the bidding process but may or may not know the parameters involved.
- Understands the short-term cost vs. the long-term value of a civil engineering project.
- Is familiar with the relationship between the designer and the construction professional; may or may not be fully aware of the various processes for conflict resolution, team-building, etc.

Level 1 performance characterized by:

- Is unfamiliar with professional practice issues related to civil engineering.
- Does not understand how the procurement works in the construction industry.
- Does not know the bidding process and/or how to conduct one.
- Does not understand the short-term vs. long-term value of civil engineering projects and may have the false impression that civil engineers need to always aim for the low-cost short-term plans (this is very typical in many third world countries).
- Is incapable of communicating with construction professionals to convey the design standards. May not be a good team player and does not know understand how to organize a team for the successful completion of a project.

Outcome 8: An understanding of professional and ethical responsibility

Level 5 performance characterized by:

- Student understands and abides by the ASCE Code of Ethics and the UD Students' Code of Conduct
- Participates in class discussions and exercises on ethics and professionalism
- Demonstrates ethical behavior among peers and faculty
- Takes personal responsibility for his/her actions
- Is punctual, professional, and collegial; attends classes regularly
- Evaluates and judges a situation in practice or as a case study, using facts and a professional code of ethics
- Uses personal value system to support actions, but understands the role of professional ethical standards for corporate decisions

Level 3 performance characterized by:

- Student is aware of the existence of the ASCE Code of Ethics and other bases for ethical behavior
- Does not take the discussion of ethics seriously but is willing to accept its existence
- Does not model ethical behavior among peers and faculty
- Doesn't recognize the need to take personal responsibility for his/her actions
- Sometimes exhibits unprofessional behavior; is sometimes absent from class without reason
- Evaluates and judges a situation in practice or as a case study using personal understanding of the situation, possibly applying a personal value system
- Uses personal value system to support actions, but confuses personal ethics with professional ethics

Level 1 performance characterized by:

- Student is not aware of any codes for ethical behavior

- Does not participate in or contribute to discussions of ethics; does not accept the need for professional ethics
- Student has been caught cheating or plagiarizing the work of others
- Blames others for own issues and problems
- Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty
- Evaluates and judges a situation in practice or as a case study using a biased perspective without objectivity
- Uses personal value system to support actions to the exclusion of all other ethical standards

Outcome 9a: Understanding of the impact of engineering in a global societal context

Level 5 performance characterized by:

- Is familiar with the current trends in the civil engineering discipline
- Respects the historical aspects of engineering solutions and their impacts
- Reads and is familiar with the content of periodicals that are relevant to understanding the global and societal impact of engineering
- Has a personal perspective on the importance (or lack thereof) of engineering in today's world

Level 3 performance characterized by:

- Is aware of current events in society
Is aware of historical aspects of engineering solutions, but is not influenced by them
- Is aware of the existence of technical periodicals - would know where to look to find them
- Is interested in engineering because of what the discipline offers him/her personally

Level 1 performance characterized by:

- Level 1 performance characterized by:
- Is unaware of current events
- Is unaware of historical effect of engineering solutions
- Is not familiar with any technical periodicals
- Isn't sure why he/she is studying engineering

Outcome 9b: A knowledge of contemporary issues

Level 5 performance characterized by:

- Has knowledge of current events in the engineering discipline and in society
- Has a good perspective on the current job market
- Able to discuss in-depth major political issues at national, state and local levels
 - Can summarize essence of several issues; take and defend a position on them
 - Is able to evaluate political solutions, or scenarios using a series of different measures - e.g., economic, quality of life; number of individuals affected; political ramifications; etc.

Level 3 performance characterized by:

- Has some knowledge of current events
- Has a somewhat narrow perspective on the current job market

- Able to comment on major political issues, but is not familiar enough with them to defend a position on them
 - Can summarize the facts of the issues
 - Can only comment on possible alternative political solutions, or scenarios using a few different measures - e.g., economic, quality of life; number of individuals affected; political ramifications; etc.

Level 1 performance characterized by:

- Has no clue about issues and events in the world
- Hopes that a job will fall into his/her lap
- Unable to comment on political solutions or is unaware of world and local happenings

Outcome 10: An ability to engage in lifelong learning

Level 5 performance characterized by:

- Demonstrates ability to learn independently
Goes beyond what is required in completing an assignment and brings information from outside sources into assignments
- Learns from mistakes and practices continuous improvement
- Demonstrates capability to think for one's self
- Demonstrates responsibility for creating one's own learning opportunities
- Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class (e.g. different nomenclature, understand equation from different textbook)
- Participates and takes a leadership role in professional and technical societies available to the student body

Level 3 performance characterized by:

- Requires guidance as to expected outcome of task or project
Completes only what is required
- Sometimes is able to avoid repeating the same mistakes
- Does not always take responsibility for own learning
- Seldom brings information from outside sources to assignments
- Has some trouble using materials and concepts that are in a different format from that taught in class
- Occasionally participates in the activities of local professional and technical societies

Level 1 performance characterized by:

- Requires detailed or step-by-step instructions to complete a task
- Has trouble completing even the minimum required tasks
- Is unable to recognize own shortcomings or deficiencies
- Assumes that all learning takes place within the confines of the class
- Shows little or no interest in outside learning resources
- Cannot use materials outside of what is explained in class
- Does not show any interest in professional and/or technical societies

Outcome 11: The ability to function on (multidisciplinary) teams

Level 5 performance characterized by:

- Routinely present at team meetings or work sessions
Contributes a fair share to the project workload

- Is prepared for the group meeting with clearly formulated ideas
- Cooperates with others (outside of the discipline)
- Shares credit for success with others and accountability for team results
- Shares information with others and provides assistance to others
- Demonstrates the ability to assume a designated role in the group
- Values alternative perspectives and encourages participation among all team members
- Remains non-judgmental when disagreeing with others/seeking conflict resolution; does not "point fingers" or blame others when things go wrong
- Is courteous group member
- Has knowledge of technical skills, issues and approaches germane to disciplines outside of civil engineering

Level 3 performance characterized by:

- Absent occasionally, but does not inconvenience group
Sometimes depends on others to complete the work; contributes less than fair share
- Prepares somewhat for group meetings, but ideas are not clearly formulated
- Occasionally works as a loner or interacts to a minor extent with extra-disciplinary team members
- Makes subtle references to other's poor performance or sometimes does not identify contributions of other team members
- Sometimes keeps information to himself/herself; not very willing to share
- Takes charge when not in the position to lead
- Persuades others to adopt only his/her ideas or grudgingly accepts the ideas of others
- Sometimes criticizes ideas of other team members or blames others for errors
- Is not always considerate or courteous towards team members
- Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members

Level 1 performance characterized by:

- Is absent from team meetings or work sessions >50% of the time
- Does not contribute to group work at all or submits own work as the group's
- Routinely fails to prepare for meetings
- Does work on his/her own; does not value team work
- Claims work of group as own or frequently blames others
- Hides in the background; only participates if strongly encouraged
- Does not willingly assume team roles
- Does not consider the ideas of others
- Is openly critical of the performance of others
- Is discourteous to other group members
- Has no knowledge of disciplines outside of civil engineering

Outcome 12a: An ability to communicate effectively (written)

Level 5 performance characterized by:

- Articulates ideas clearly and concisely
- Organizes written materials in a logical sequence to enhance the reader's comprehension (paragraphs, subheading, etc.)

- Uses graphs, tables, and diagrams to support points-to explain, interpret, and assess information
- Written work is presented neatly and professionally
- Grammar and spelling are correct
- Figures are all in proper format
- Uses good professional writing style
- Conforms to the prescribed format (if any)

Level 3 performance characterized by:

- Articulates ideas, but writing is somewhat disjointed, superfluous or difficult to follow
- Material are generally organized well, but paragraphs combine multiple thoughts or sections and sub-sections are not identified clearly
- Uses graphs, tables, and diagrams, but only in a few instances are they applied to support, explain or interpret information
- Work is not neatly presented throughout
- One or two spelling/grammar errors per page
- Figures are present but are flawed-axes mislabeled, no data points, etc.
- Style is informal or inappropriate, jargon is used, improper voice, tense...
- The prescribed format is only followed in some portions of the paper

Level 1 performance characterized by:

- Text rambles, points made are only understood with repeated reading, and key points are not organized
- Little or no structure or organization; no subheadings or proper paragraph structure used
- Graphs, tables or diagrams are used, but no reference is made to them
- Work is not presented neatly
- Spelling/grammar errors present throughout more than 1/3 of the paper
- No figures or graphics are used at all
- The writing style is inappropriate for the audience and for the assignment
- The prescribed format is not followed

Outcome 12b: An ability to communicate effectively (oral)

Level 5 performance characterized by:

- Plans and delivers an oral presentation effectively; applies the principle of "(tell them)3" --well organized
- Presentation has enough detail appropriate and technical content for the time constraint and the audience
Presents well mechanically
 - Makes eye contact
 - Can be easily heard
 - Speaks comfortably with minimal prompts (notecards)
 - Does not block screen
 - No distracting nervous habits
- Uses proper American English
- Uses visual aides effectively
- Professional appearance

- Listens carefully and responds to questions appropriately; is able to explain and interpret results for various audiences and purposes

Level 3 performance characterized by:

- Presents key elements of an oral presentation adequately, but "tell them" not clearly applied
Presentation contains excessive or insufficient detail for time allowed or level of audience
- Has some minor difficulties with the mechanical aspects of the presentation
 - Eye contact is sporadic
 - Occasionally difficult to hear or understand speaking
 - Overuses prompts or does not use prompts enough-occasionally stumbles or loses place; appears to have memorized presentation
 - Occasionally blocks screen
 - Some nervous habits (um, ah, clicking pointer, etc.)
- Occasionally uses an inappropriate style of English-too conversational
- Visual aides have minor errors or are not always clearly visible
Appearance is too casual for the circumstances
- Sometimes misunderstands questions, does not respond appropriately to the audience, or has some trouble answering questions

Level 1 performance characterized by:

- Talk is poorly organized, e.g. no clear introduction or summary of talk is presented
- Presentation is inappropriately short or excessively long; omits key results during presentation
- Major difficulties with the mechanical aspects of the presentation
 - No eye contact
 - Difficult to hear or understand speaking
 - Reads from prepared script
 - Blocks the screen
 - Distracting nervous habits (um, ah, clicking pointer, etc.)
- Uses poor English
- Multiple slides are unclear or incomprehensible
- Does not listen carefully to questions, does not provide an appropriate answer, or is unable to answer questions about presentation material

1) An ability to identify, formulate, and solve engineering problems

Level 5 performance characterized by:

Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information

Can relate theoretical concepts to practical problem solving

Can predict and defend problem outcomes

Uses appropriate resources to locate information needed to solve problems

Takes new information and effectively integrates it with previous knowledge

Demonstrates understanding of how various pieces of the problem relate to each other and the whole

Formulates strategies for solving problems

The answer is correct and properly labeled

The solution is correct and checked in other ways when it can be; the interpretation is appropriate and makes sense

Level 3 performance characterized by:

Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated

Connects theoretical concepts to practical problem-solving when prompted

Occasionally predicts and defends problem outcomes

Uses limited resources to solve problems

Must be assisted in integrating previous knowledge and new information

Is missing some of the pieces of the whole problem

Has some strategies for problem-solving, but does not apply them consistently

The answer is nearly correct, but properly labeled (within reasonable and logical range of the correct answer—it's in the "ballpark")

The solution is correct, but not checked in other ways

Level 1 performance characterized by:

Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems

Does not see the connection between theory and practical problem solving

Is unable to predict or defend problem outcomes

Uses no resources to solve problems

Has no concept of how previous knowledge and new information relate

Does not realize when major components of the problem are missing

Has no coherent strategies for problem solving

The answer is incorrect and not checked for its reasonableness

No attempt at checking the obviously incorrect solution—no commentary

1a) An ability to apply math & science in engineering

Level 5 performance characterized by:

Combines mathematical &/or scientific principles to formulate models of chemical, physical and/or biological processes and systems relevant to

chemical engineering

Applies concepts of integral and differential calculus and/or linear algebra to solve chemical engineering problems

Shows appropriate engineering interpretation of mathematical and scientific terms

Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality

Executes calculations correctly

By hand

Using mathematical software

Correctly analyzes data sets using statistical concepts

Level 3 performance characterized by:

Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development

Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving

Most mathematical terms are interpreted correctly

Some gaps in understanding the application of theory to the problem and expects theory to predict reality

Minor errors in calculations

By hand

Applying math software

Minor errors in statistical analysis of data

Level 1 performance characterized by:

Does not understand the connection between mathematical models and chemical, physical, and/or biological processes and systems in chemical engineering

Does not understand the application of calculus and linear algebra in solving chemical engineering problems

Mathematical terms are interpreted incorrectly or not at all

Does not appear to grasp the connection between theory and the problem

Calculations not performed or performed incorrectly

By hand

Does not know how to use math software

No application of statistics to analysis of data

1b) An ability to use the techniques, skills, and modern tools of engineering practice

Level 5 performance characterized by:

Uses computer-based and other resources effectively in assignments/projects

Seeks information on problems from multiple resources

Is able to interpret and understand information from a variety of resources

Maintains current, state-of-the-art abilities in PC use

Is able to learn and implement process simulation software

Understand the organization and use of the library

Level 3 performance characterized by:

Uses computer-based and other resources occasionally in assignments/projects

Looks only to class resources in solving problems and homework
Requires assistance in interpretation of information from outside resources
and/or only uses a small number of outside resources
Can perform simple tasks requiring personal computer use
Has difficulty implementing process simulation and other software
Requires assistance in locating materials from the library

Level 1 performance characterized by:

Does not use computer-based and other resources for assignments and projects
Often does not even use the course textbook to help solve problems or
homework (comes to office hours unprepared)
Is not willing to use outside resources unless required
Struggles with simple tasks in PC use and is unable to use current software
packages
Relies on others to perform tasks in which computer-based skills are required
Does not use the library

2) *An ability to design a system, component or process*

Level 5 performance characterized by:

Develops a design strategy, including a plan of attack, decomposition of work
into subtasks, development of a timetable
Suggests new approaches and improves on what has been done before
Develops several potential solutions and finds optimum
Understands how areas interrelate and demonstrates ability to integrate prior
knowledge into a new problem
Thinks holistically: sees the whole as well as the parts
Uses computer tools and engineering resources effectively
Supports design procedure with documentation and references
Develops a solution that includes economic, safety, environmental and other
realistic constraints
Applies engineering and/or scientific principles correctly to design practical
processes
Recognizes practical significance of design outcome/answer (i.e. no
outrageously sized reactors, 600 m towers, or pipes 1 mile in diameter!)

Level 3 performance characterized by:

Uses a design strategy with guidance
Can follow a previous example competently
Can develop and compare multiple solutions to a problem, but does not
usually arrive at the best result; conducts optimization but neglects one or two
key aspects
Can use prior knowledge to design individual pieces of equipment
competently when guided to do so
Does not think holistically: does not see the integration of the pieces clearly
Minimal or incorrect use of computer tools and engineering resources
Design is done, but procedures and equations are not documented or
referenced
Includes only minor or cursory consideration of economic, safety, and

environmental constraints

Applies engineering and/or scientific principles incompletely or incorrectly to design a practical processes

Gives an answer, but does not check its practicality

Level 1 performance characterized by:

No design strategy; haphazard approach

Cannot design processes or individual pieces of equipment without significant amounts of help

Only focuses on one solution to a problem; no optimization attempted

Unable to relate prior knowledge to the design problem

Has no concept of the process as a sum of its parts

No use of computer tools and engineering resources

Design is done incompletely without the proper equations and without references

No consideration of economics, safety, and environment

No application of engineering and/or scientific principles

Design is incomplete, no answer is given

3) *An ability to design and conduct experiments, analyze and interpret data*

Level 5 performance characterized by:

Observes good laboratory safety procedures

Formulates an experimental plan of data gathering to attain a stated objective (develop correlation, test a model, ascertain performance of equipment, etc.)

Carefully documents data collected

Develops and implements logical experimental procedures

Can select appropriate equipment and instruments to perform the experiment

Is able to operate instrumentation and process equipment

Analyzes and interprets data carefully using appropriate theory; if required, translates theory into practice or applies to process model(s)

Is aware of measurement error and is able to account for it statistically

Seeks information for experiment(s) from multiple sources

Level 3 performance characterized by:

Unsafe lab procedures observed infrequently

Develops a simplistic experimental plan of data gathering, does not recognize entire scope of study (e.g. not all parameters affecting the results are investigated)

Data collected are not all documented, units are missing, or some measurements are not recorded

Experimental procedures most often followed, but occasional oversight leads to loss of experimental efficiency and/or loss of data

Needs some guidance in selecting appropriate equipment and instrumentation

Is tentative in operation of instruments and process equipment

Applies appropriate theory to data when prompted to do so, but misinterprets physical significance of theory or variable involved; makes errors in unit conversions

Is aware of measurement error but does not account for it statistically or does

so at a minimal level

Seeks information for experiment(s) from a few sources—mainly from the textbook or the instructor

Level 1 performance characterized by:

Practices unsafe, risky behaviors in lab

No systematic plan of data gathering; experimental data collection is disorganized, even random, and incomplete

Data are poorly documented

Does not follow experimental procedure

Cannot select the appropriate equipment and instrumentation required to run the experiment(s)

Does not operate instrumentation and process equipment, does so incorrectly or requires frequent supervision

Makes no attempt to relate data to theory

Is unaware of measurement error

Seeks no extra information for experiments other than what is provided by instructor

4a) An ability to communicate effectively (oral)

Level 5 performance characterized by:

Plans and delivers an oral presentation effectively; applies the principle of “(tell them)³”—well organized

Presentation has enough detail appropriate and technical content for the time constraint and the audience

Presents well mechanically

Makes eye contact

Can be easily heard

Speaks comfortably with minimal prompts (notecards)

Does not block screen

No distracting nervous habits

Uses proper American English

Uses visual aides effectively

Professional appearance

Listens carefully and responds to questions appropriately; is able to explain and interpret results for various audiences and purposes

Level 3 performance characterized by:

Presents key elements of an oral presentation adequately, but “tell them³” not clearly applied

Presentation contains excessive or insufficient detail for time allowed or level of audience

Has some minor difficulties with the mechanical aspects of the presentation

Eye contact is sporadic

Occasionally difficult to hear or understand speaking

Overuses prompts or does not use prompts enough—occasionally stumbles or loses place; appears to have memorized presentation

Occasionally blocks screen

Some nervous habits (um, ah, clicking pointer, etc.)

Occasionally uses an inappropriate style of English—too conversational

Visual aides have minor errors or are not always clearly visible

Appearance is too casual for the circumstances

Sometimes misunderstands questions, does not respond appropriately to the audience, or as some trouble answering questions

Level 1 performance characterized by:

Talk is poorly organized, e.g. no clear introduction or summary of talk is presented

Presentation is inappropriately short or excessively long; omits key results during presentation

Major difficulties with the mechanical aspects of the presentation

No eye contact

Difficult to hear or understand speaking

Reads from prepared script

Blocks the screen

Distracting nervous habits (um, ah, clicking pointer, etc.)

Uses poor English

Multiple slides are unclear or incomprehensible

Does not listen carefully to questions, does not provide an appropriate answer, or is unable to answer questions about presentation material

4b) An ability to communicate effectively (written)

Level 5 performance characterized by:

Articulates ideas clearly and concisely

Organizes written materials in a logical sequence to enhance the reader's comprehension (paragraphs, subheading, etc.)

Uses graphs, tables, and diagrams to support points--to explain, interpret, and assess information

Written work is presented neatly and professionally

Grammar and spelling are correct

Figures are all in proper format

Uses good professional writing style

Conforms to the prescribed format (if any)

Level 3 performance characterized by:

Articulates ideas, but writing is somewhat disjointed, superfluous or difficult to follow

Material are generally organized well, but paragraphs combine multiple thoughts or sections and sub-sections are not identified clearly

Uses graphs, tables, and diagrams, but only in a few instances are they applied to support, explain or interpret information

Work is not neatly presented throughout

One or two spelling/grammar errors per page

Figures are present but are flawed—axes mislabeled, no data points, etc

Style is informal or inappropriate, jargon is used, improper voice, tense ...

The prescribed format is only followed in some portions of the paper

Level 1 performance characterized by:

Text rambles, points made are only understood with repeated reading, and key points are not organized

Little or no structure or organization; no subheadings or proper paragraph structure used

Graphs, tables or diagrams are used, but no reference is made to them

Work is not presented neatly

Spelling/grammar errors present throughout more than 1/3 of the paper

No figures or graphics are used at all

The writing style is inappropriate for the audience and for the assignment

The prescribed format is not followed

5) *An understanding of professional and ethical responsibility*

Level 5 performance characterized by:

Student understands the Code of Professional Engineers and the MSU Students' Rights and Responsibilities Document

Participates in class discussions and exercises on ethics and professionalism

Demonstrates ethical behavior among peers and faculty

Takes personal responsibility for his/her actions

Is punctual, professional, and collegial; attends classes regularly

Evaluates and judges a situation in practice or as a case study, using facts and a professional code of ethics

Uses personal value system to support actions, but understands the role of professional ethical standards for corporate decisions

Level 3 performance characterized by:

Student is aware of the existence of the Code of Professional Engineers and other bases for ethical behavior

Does not take the discussion of ethics seriously but is willing to accept its existence

Does not model ethical behavior among peers and faculty

Doesn't recognize the need to take personal responsibility for his/her actions

Sometimes exhibits unprofessional behavior; is sometimes absent from class without reason

Evaluates and judges a situation in practice or as a case study using personal understanding of the situation, possibly applying a personal value system

Uses personal value system to support actions, but confuses personal ethics with professional ethics

Level 1 performance characterized by:

Student is not aware of any codes for ethical behavior

Does not participate in or contribute to discussions of ethics; does not accept the need for professional ethics

Student has been caught cheating or plagiarizing the work of others

Blames others for own issues and problems

Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty

Evaluates and judges a situation in practice or as a case study using a biased

perspective without objectivity

Uses personal value system to support actions to the exclusion of all other ethical standards

6) *The ability to function on (multidisciplinary) teams and demonstration of team skills in general*

Level 5 performance characterized by:

Routinely present at team meetings or work sessions

Contributes a fair share to the project workload

Is prepared for the group meeting with clearly formulated ideas

Cooperates with others (outside of the discipline)

Shares credit for success with others and accountability for team results

Shares information with others and provides assistance to others

Demonstrates the ability to assume a designated role in the group

Values alternative perspectives and encourages participation among all team members

Remains non-judgmental when disagreeing with others/seeking conflict resolution; does not "point fingers" or blame others when things go wrong

Is a courteous group member

Has knowledge of technical skills, issues and approaches germane to disciplines outside of chemical engineering

Level 3 performance characterized by:

Absent occasionally, but does not inconvenience group

Sometimes depends on others to complete the work; contributes less than fair share

Prepares somewhat for group meetings, but ideas are not clearly formulated

Occasionally works as a loner or interacts to a minor extent with extradisciplinary team members

Makes subtle references to other's poor performance or sometimes does not identify contributions of other team members

Sometimes keeps information to himself/herself; not very willing to share

Takes charge when not in the position to lead

Persuades others to adopt only his/her ideas or grudgingly accepts the ideas of others

Sometimes criticizes ideas of other team members or blames others for errors

Is not always considerate or courteous towards team members

Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members

Level 1 performance characterized by:

Is absent from team meetings or work sessions >50% of the time

Does not contribute to group work at all or submits own work as the group's

Routinely fails to prepare for meetings

Does work on his/her own; does not value team work

Claims work of group as own or frequently blames others

Hides in the background; only participates if strongly encouraged

Does not willingly assume team roles

- Does not consider the ideas of others
- Is openly critical of the performance of others
- Is discourteous to other group members
- Has no knowledge of disciplines outside of chemical engineering

7) *Understanding of the impact of engineering in a global societal context*

Level 5 performance characterized by:

- Is familiar with the current trends in the chemical engineering discipline
- Respects the historical aspects of engineering solutions and their impacts
- Reads and is familiar with the content of periodicals that are relevant to understanding the global and societal impact of engineering
- Has a personal perspective on the importance (or lack thereof) of engineering in today's world

Level 3 performance characterized by:

- Is aware of current events in society
- Is aware of historical aspects of engineering solutions, but is not influenced by them
- Is aware of the existence of technical periodicals—would know where to look to find them
- Is interested in engineering because of what the discipline offers him/her personally

Level 1 performance characterized by:

- Is unaware of current events
- Is unaware of historical effect of engineering solutions
- Is not familiar with any technical periodicals
- Isn't sure why he/she is studying engineering

8) *An ability to engage in lifelong learning*

Level 5 performance characterized by:

- Demonstrates ability to learn independently
- Goes beyond what is required in completing an assignment and brings information from outside sources into assignments
- Learns from mistakes and practices continuous improvement
- Demonstrates capability to think for one's self
- Demonstrates responsibility for creating one's own learning opportunities
- Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class (e.g. different nomenclature, understand equation from different textbook)
- Participates and takes a leadership role in professional and technical societies available to the student body

Level 3 performance characterized by:

- Requires guidance as to expected outcome of task or project
- Completes only what is required
- Sometimes is able to avoid repeating the same mistakes
- Does not always take responsibility for own learning
- Seldom brings information from outside sources to assignments

Has some trouble using materials and concepts that are in a different format from that taught in class

Occasionally participates in the activities of local professional and technical societies

Level 1 performance characterized by:

Requires detailed or step-by-step instructions to complete a task

Has trouble completing even the minimum required tasks

Unable to recognize own shortcomings or deficiencies

Assumes that all learning takes place within the confines of the class

Shows little or no interest in outside learning resources

Cannot use materials outside of what is explained in class

Does not show any interest in professional and/or technical societies

9) A knowledge of contemporary issues

Level 5 performance characterized by:

Has knowledge of current events in the engineering discipline and in society

Has a good perspective on the current job market

Able to discuss in-depth major political issues at national, state and local levels

Can summarize essence of several issues; take and defend a position on them

Is able to evaluate political solutions, or scenarios using a series of different measures –e.g., economic, quality of life; number of individuals affected; political ramifications; etc.

Level 3 performance characterized by:

Has some knowledge of current events

Has a somewhat narrow perspective on the current job market

Able to comment on major political issues, but is not familiar enough with them to defend a position on them

Can summarize the facts of the issues

Can only comment on possible alternative political solutions, or scenarios using a few different measures –e.g., economic, quality of life; number of individuals affected; political ramifications; etc.

Level 1 performance characterized by:

Has no clue about issues and events in the world

Hopes that a job will fall into his/her lap

Unable to comment on political solutions or is unaware of world and local happenings

**Scoring Rubric
FOR UNIVERSITY OF WASHINGTON ENGINEERING WRITING**

Downloaded January 30, 2006 from www.uwtc.washington.edu/research/ewc/Rubricfinal.d

S = Strong
A = Acceptable
W = Weak

OUTCOMES	EVALUATION		
<p>1. The CONTENT of the document, including text and other elements, is effective. It:</p> <ul style="list-style-type: none"> • Clearly states the purpose, providing an explicit justification for the document. • Explicitly defines the scope for the reader. • Is factually correct. • Supports the purpose thoroughly and concisely. • Substantiates claims and, when appropriate, addresses alternative claims. • Shows that the writer understands the topic under discussion. • Uses language to connect the pieces of the argument or document. • Uses non-textual elements (graphs, charts, equations) that are necessary for clarity, are complete, and are referred to and explained appropriately in the text. 	S	A	W
<p>2. The document is well-ORGANIZED for its intended audience and purpose. It:</p> <ul style="list-style-type: none"> • Exhibits a logical progression and structures the content to represent that logical progression. • Uses headings and subheadings, when appropriate, to make the document's organization apparent to the reader. 			
<p>3. STYLE and TONE are appropriate for the intended audience and purpose. The style (word choice, sentence structure, voice):</p> <ul style="list-style-type: none"> • Holds the reader's interest. • Includes a variety of sentence structures. • Shows appropriate use of active and passive voice. • Through vocabulary, demonstrates an understanding of the content, concepts, and methods in the discipline. <p>The tone (the writers' attitude toward the reader, the topic, and themselves):</p> <ul style="list-style-type: none"> • Takes the reader's knowledge into consideration. • Matches the purpose in the level of formality. • Represents a voice that is authentic and credible, so the reader believes that the writer understands the topic. 			
<p>4. The document shows knowledge of writing FUNDAMENTALS. The writing:</p> <ul style="list-style-type: none"> • Conforms to conventions or requirements of the document type. • Uses correct punctuation, grammar, usage, and spelling. • Uses proper citation form. 			
<p>5. The PRESENTATION is appropriate for the intended audience and purpose. It:</p> <ul style="list-style-type: none"> • Is designed to help readers navigate through content. • Provides clear labels for tables, figures, and equations and uses sufficient space around these non-textual elements. 			
<p>6. The writing demonstrates an understanding of the ETHICS governing writing. The writing:</p> <ul style="list-style-type: none"> • Includes citations for other's ideas, including any information and non-textual material from sources outside the writer. • Does not use data selectively to manipulate the reader. • Acknowledges ideas or data that challenge the writer's conclusions. 			
Overall Evaluation of Paper			