Angelo State University

David L. Hirschfeld Department of Engineering

Performance Indicators & Rubrics

David L. Hirschfeld Department of Engineering adopts the new ABET's proposed Student Outcome criteria, as follows:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Rubric for Performance Indicators of Student Outcome (1): An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
1a) Identify specific facts of engineering, science, and mathematics needed for a given situation	Little knowledge of facts Cannot identify the specific facts for a given situation Missing the key facts	Identifies some specific facts for a given situation, but many facts are missing.	Identifies the key facts for the given situation.	Identifies all the relevant facts for the given situation
1b) Formulate the problem and identify key issues/variables, model real world situation	Missing problem formulation Missing most key issues / variables Unable to convert a real world situation into a model	Weak problem formulation Some issues / variables identified, but many missing Partially converts a real world situation into a model	Adequate problem formulation Most key issues / variables are identified Converts a real world situation into an appropriate model	Complete and succinct problem formulation Key issues / variables identified Converts a real world situation into the most appropriate model with respect to the problem context
1c) Solve complex engineering problems	Unable to generate solution or generates solution that is flawed in concept or in computation; solution is not checked for correctness or consistency.	Generate solution which is corrects partially correct in concept or in computation; solution is seldom checked for correctness or consistency.	Generates solution that is correct in part, (e.g., numerically correct and is missing units); solution is not always checked.	Generates correct solutions; checks solution upon completion; interprets solution appropriately.

Adopted and modified, from:

Illinois Institute of Technology, "PI Rubric – Student Outcomes (1), (4), and (6)", Student Outcomes, Performance Indicators, and Rubrics. Retrieved from: http://www.ece.iit.edu/~abet/sopi.html [Last Accessed March 7, 2020].

Michigan State University, Chemical Engineering and Materials Department, "Outcome 1: An ability to identify, formulate and solve engineering problems; Performance Indicator Scoring Rubrics". Retrieved from: https://www.chems.msu.edu/sites/default/files/content/docs/che1.pdf [Last Accessed March 7, 2020].

Rubric for Performance Indicators of Student Outcome (2): An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
2a) Identify problem, criteria, constraints	Problem is not identified. Criteria and constraints are missing.	Problem is difficult to identify. Criteria and constraints are partly missing or marginally stated.	Problem is generally identified. Most criteria and constraints are stated fairly clearly.	Problem is clearly identified. Criteria and constraints are clearly stated.
2b) Define the problem, review possible solutions, select design	Research is missing. Ideas generated are one person's or are missing. Design selection is missing or shows no thought.	Research uses 1 or 2 sources and barely cites them. Ideas generated reflect limited views or approaches. Design selection is rushed and lacks deliberation.	Research uses 2 or 3 sources and generally cites them. Ideas generated reflect some views and approaches. Design selection is fairly thoughtful and deliberate.	Research uses and cites 3 or more sources. Ideas generated reflect many views and approaches. Design selection is thoughtful and deliberate.
2c) Design, assess, refine and conclude the model or prototype	Design is missing or lacks any accuracy or dimensions. Testing is missing or has no documentation. Refinements of design are missing. Conclusion is missing or inadequate.	Design is modeled and/or built with little accuracy or with correct dimensions. Testing is rushed and barely documented. Refinements are barely done or reflect little deliberation. Conclusion is too general and gives little or no proof for any assertions.	Design is modeled and/or built fairly accurately with mostly correct dimensions. Testing is fairly thorough and mostly documented. Refinements reflect some deliberation. Conclusion is fairly detailed and gives some proof for any assertions.	Design is modeled and/or built accurately with correct dimensions. Testing is thorough and well documented. Refinements reflect thoughtful deliberation. Conclusion is detailed and gives strong proof for any assertions.

Adopted and modified, from:

Academy of Aerospace and Engineering, "Engineering Design Process Rubric". Retrieved from https://aerospaceandengineeringacademy.files.wordpress.com/2015/09/engineering-design-process-rubric1.pdf [Last Accessed March 7, 2020].

Rubric for Performance Indicators of Student Outcome (3): An ability to communicate effectively with a range of audiences.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
3a) Use Appropriate context & conventions	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience). Attempts to use a consistent system for basic organization and presentation.	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions). Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context). Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choice	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work. Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices
3b) Use credible sources, evidence & structure	Demonstrates an attempt to use sources to support ideas in the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing
3c) Use proper syntax & mechanics	Uses language that sometimes impedes meaning because of errors in usage.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.
3d) Demonstrate proper oral presentation mechanics	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is not observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is intermittently	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable and is

	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) detract from the understandability of the presentation, and speaker appears uncomfortable.	observable within the presentation. Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation understandable, and speaker appears tentative	observable within the presentation. Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation interesting, and speaker appears comfortable	skillful and makes the content of the presentation cohesive. Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and speaker appears polished and confident

Adapted from AACU VALUE rubrics for written and oral communications:

Association of American Colleges & Universities (AAC&U), "VALUE Rubrics: Written Communication, Oral Communication, Ethical Reasoning, and Foundations and Skills for Lifelong Learning". Retrieved from https://www.aacu.org/value-rubrics [Last Accessed March 7, 2020].

Rubric for Performance Indicators of Student Outcome (4): An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
4a) Recognize ethical and professional responsibilities	Student can recognize basic and obvious ethical and professional issues but fails to grasp complexity or interrelationships.	Student can recognize basic and obvious ethical & professional issues and grasp (incompletely) the complexities or interrelationships among the issues.	Student can recognize ethical and professional issues when issues are presented in a complex, multilayered (gray) context OR can grasp cross-relationships among the issues.	Student can recognize ethical and professional issues when presented in a complex, multilayered (gray) context AND can recognize cross-relationships among the issues.
4b) Define Ethical and professional perspectives and concepts.	Student states a position but cannot state the objections to and assumptions and limitations of the different perspectives/concepts.	Student states a position and can state the objections to, assumptions and implications of different ethical perspectives/concepts but does not respond to them (and ultimately objections, assumptions, and implications are compartmentalized by student and do not affect student's position.)	Student states a position and can state the objections to, assumptions and implications of, and respond to the objections to, assumptions and implications of different ethical perspectives/concepts, but the student's response is inadequate.	Student states a position and can state the objections to, assumptions and implications of and can reasonably defend against the objections to, assumptions and implications of different ethical perspectives/concepts, and the student's defense is adequate and effective.
4c) Make informed judgements considering global, economic, environmental and societal context.	Explanation of relevant impacts of engineering decisions absent or extremely limited.	Explanation of relevant impacts of engineering decisions is rudimentary.	Explanation is substantive in the majority of contexts.	Explanation is at least substantive in all contexts and is thorough in the majority.

Adopted and modified, from:

Illinois Institute of Technology, "PI Rubric – Student Outcomes (1), (4), and (6)", Student Outcomes, Performance Indicators, and Rubrics. Retrieved from: http://www.ece.iit.edu/~abet/sopi.html [Last Accessed March 7, 2020].

Association of American Colleges & Universities (AAC&U), "VALUE Rubrics: Written Communication, Oral Communication, Ethical Reasoning, and Foundations and Skills for Lifelong Learning". Retrieved from https://www.aacu.org/value-rubrics [Last Accessed March 7, 2020].

Rubric for Performance Indicators of Student Outcome (5): An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
5a) Performs on a team	Satisfied even if the team does not meet assigned standards and wants the team to avoid work. Is unaware of whether the team is meeting its goals. Avoids discussing team problems, even when they are obvious.	Satisfied if team meets acceptable standards and will agree to needed level of work to do so. Responds when other teammates present issues affecting team's progress. Will engage when other teammates make suggestions.	Believes that the team can fully meet its responsibilities and encourages them to do good work. Notices changes that influence the team's success. Alerts teammates or suggests solutions when the team's success is threatened.	Believes team can do excellent work and motivates them to do so. Watches conditions affecting the team and monitors the team's progress. Gives teammates specific, timely, and constructive feedback.
5b) Organize and complete work	Lack of clearly established goals with realistic tasks and deadlines has significant negative impact to project. Misses deadlines. Is late, unprepared, or significant absences at team meetings.	Have general goals with some tasks and simple milestone schedule; which aid in project completion. Meets easy deadlines but misses harder ones. Full attendance at most team meetings but often under prepared.	Establishes clear goals with realistic tasks. Has a Gantt type schedule identifying most critical tasks with realistic schedule; sufficient to aid in project completion. Completes majority of assignments on time. Essentially full attendance at most team meetings with adequate preparation.	Establishes clear goals with realistic tasks. Uses Gantt type schedule to actively manage project to reach objectives. Completes all essential tasks on time. Meetings carefully planned in advance, essentially full attendance nearly all the time.
5c) Practices a collaborative team environment	Teammates interrupt, ignore, boss, or make fun of one another. Teammates take actions that affect one another without their input. Do not share information. Teammates complain, makes excuses, or do not interact with one another. Accept no help or advice.	Teammates do much of the talking; do not actively listen to contribution of one another. Team communications often one-way or limited. Limited sharing of information. Limited individual participation in team activities.	Teammates listen to one another and respects their contributions. Teammates communicate clearly & share information with one another. Participate fully in team activities. Teammates respect and respond to feedback from one another.	Teammates ask for and show an interest in one another's ideas and contributions. Teammates improve communication among one another. Provide encouragement or enthusiasm to bring all members into active team participation.

		Teammates listen to but often ignore feedback of one another.		Teammates ask one another for feedback and use their suggestions to improve
5d) Creates an inclusive environment	Displays little or no interest in interacting with people different from themselves. Unaware or minimally aware of the need or value of interacting with people different from themselves	Displays curiosity and interest in interacting with people different from themselves. Begin to recognize limitations of their own views and the value of interacting with people different from themselves.	Able to interact with people different from themselves. Able to connect scholarship to questions of diversity.	Able to engage skillfully with people different from themselves in order to develop a pluralist domestic and worldview.

Adapted from:

Loughry, M. L., Ohland, M. W., & Moore, D. D., "Development of a theory-based assessment of team member effectiveness". Educational and Psychological Measurement, 67(3), 505-524, 2007.

Loughry, M. L., Ohland, M. L., & Woehr, D. J., "Assessing teamwork skills for assurance of learning using CATME Team Tools". *Journal of Marketing Education*, 36(1), 5-19, 2014.

University of Wisconsin- Whitewater, "Diversity Learning and Intercultural Competence Rubric". Retrieved from: https://www.uww.edu/Documents/acadaff/ToolKit/Diversity%20Learning%20Intercultural%20Competence%20Rubric,%20SHORT.pdf [Last Accessed March 7, 2020].

Additional related .pdfs found at:

http://info.catme.org/wp-content/uploads/Word-Documents-for-CATME-Peer-Evaluation.doc

http://www.uww.edu/Documents/acadaff/ToolKit/Diversity%20Learning%20Intercultural%20Competence%20Rubric,%20SHORT.pdf

Specific Information on Adaptation:

5a) adapted from CATME areas "Keeping the Team on Track" and "Expecting quality"
5b) adapted from CATME areas "Contributing to the Team's Work" and "Having Relevant Knowledge, Skills and Abilities" with additional measures on goal setting, time & risk management.
5c) adapted from CATME area "Interacting with Teammates"
5d) adapted from University of Wisconsin Whitewater *Diversity Learning and Intercultural Competence Rubric*

Rubric for Performance Indicators of Student Outcome (6): An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
6a) Design and conduct experiment plan	Missing Experiment Plan and/or Driving Questions Missing identification of key variables and/or Data collected for variables that are not part of Experiment Plan or some variables are not sampled Missing data collection procedure OR Data collection appears to have significant errors or unrealistic accuracy (fake data?)	Flawed Experiment Plan and/or Weak Driving Question Majority of key variables are not identified and/or Data collection procedure is formulated poorly Data collection process is not described , illustrated or diagramed (test setup not adequately described) and does not include any detail on instrument precision or accuracy performance (sensitivity & calibration) Input data range is significantly limited or obviously meaningless for some variables	Adequate Experiment Plan with Driving Question that have minor flaws Data collection procedure is formulated adequately, but does not account for all externalities and Input data covers most of the "range of interest" for the key variables Data collection includes most instrument capabilities (sensitivity & calibration) Data collection process is illustrated / explained, but a few minor details are missing	Well thought out Experiment Plan with appropriately narrow and focused Driving Question is Data collection procedure is detailed without being unnecessarily complicated And includes all relevant sensitivity and calibration information Data collection setup is carefully and thoroughly explained Input data covers entire range of interest, as well as some additional points / configurations that might be of interest without wasting time on unnecessary procedures
6b) Analyze and interpret experimental data	Missing large portions of data range No comparison made with standards, references, models or comparison made to nonsensical references, standards, models	Weak comparison of data to appropriate standards, references, models Comparison of data made to references, standards, models that doesn't include some important relationships among key variables	Adequate comparison made to appropriate references, standards, models Model includes important relationships among key variables, though some minor details are missing	Thorough comparison conducted between sufficiently varied data set and detailed references, standards, models

6c) Make recommendations based on the use of experiment findings	Inappropriate use of finding Weak on inconclusive recommendations based on findings	Acceptable use of findings Adequate recommendations but fail to connect recommendations to experiment	Appropriate use of findings Recommendations based on experiment provided	Effectively uses experimental findings to make recommendations Offers substantial support for the recommendations and connects findings to the recommendations

Adopted and modified, from:

Illinois Institute of Technology, "PI Rubric – Student Outcomes (1), (4), and (6)", Student Outcomes, Performance Indicators, and Rubrics. Retrieved from: http://www.ece.iit.edu/~abet/sopi.html [Last Accessed March 7, 2020].

Rubric for Performance Indicators of Student Outcome (7): An ability to acquire and apply new knowledge as needed using appropriate learning strategies.

Performance Indicator	**1: Beginning**	**2: Developing**	**3: Proficient**	**4: Exemplary**
7a) Display an awareness that education is continuous beyond classroom and an understanding for how to apply that new knowledge	Completes required work. Begins to look beyond classroom requirements, showing interest in pursuing knowledge independently.	Completes required work and identifies opportunities to expand knowledge, skills, and abilities. Beyond classroom requirements, pursues additional knowledge and/or shows interest in pursuing independent educational experiences.	Completes required work, identifies and pursues opportunities to expand knowledge, skills, and abilities. Beyond classroom requirements, pursues substantial, additional knowledge and/or actively pursues independent educational experiences.	Completes required work, generates and pursues opportunities to expand knowledge, skills, and abilities. Educational interests and pursuits exist and flourish outside classroom requirements. Knowledge and/or experiences are pursued independently.
7b) Select learning strategy suited for the acquisition of needed knowledge	Unaware of alternative learning strategies	Aware of multiple learning strategies and attempts to implement different approaches to different subjects.	Regularly employs various learning strategies	Adept at multiple types of learning strategies and regularly employs multiple learning strategies

Adopted and modified, from: AACU VALUE rubric for lifelong learning:

Association of American Colleges & Universities (AAC&U), "VALUE Rubrics: Written Communication, Oral Communication, Ethical Reasoning, and Foundations and Skills for Lifelong Learning". Retrieved from https://www.aacu.org/value-rubrics [Last Accessed March 7, 2020].