Results

The undergraduate degree offered by the General and Basic Engineering department is the BS in Engineering (often called General Engineerin) The degree is jointly offered with East Tennessee State University. This degree began in Fall of 2016 and became eligible for ABET accreditation in 2021. In October of 2021, the program underwent the ABET site visit for initial accreditation. Based on this visit, the program continued to improve the assessment process and metrics being used. The program submitted a 30-day response and a post 30-day response and was able to resolve the one program weakness that was sited at the visit. As a result, ABET has officially accredited the program as of August 2022, retroactive for all program graduates.

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

ENGR 4950, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Identify			
Demonstrates understanding of problem scenario by developing a well-written problem/opportunity statement		4 S1, S2, S3, S4	
Identifies problem requirements through clear statement of constraints, criteria, variables, and objectives	1 S3	3 S1, S2, S4	
Identifies appropriate modeling approaches related to the engineering system	2 S3, S4	2 S1, S3	
Formulate			
Subdivides complex problems into smaller, more tractable problems		4 S1, S2, S3, S4	
Simplifies complex problem into idealized model(s)		4 S1, S2, S3, S4	
Develops appropriate math/science/engineering model	2 S3, S4	2 S1, S2	
Identifies viable solution approaches	1 S4	3 S1, S2, S3	
Makes reasonable assumptions for models and recognizes limitations so that the appropriate one is selected for the context or application		4 S1, S2, S3, S4	
Solve			
Selects and applies effective solution procedures/techniques/tools correctly	1 S4	3 S1, S2, S3	
Solves math model using analytical, numerical, and/or approximate methods	1 S4	3 S1, S2, S3	

Verifies that the solution is practical and can be implemented		N/A	
Validates that the solution is appropriate and reasonably represents the original problem		N/A	

This assessment was based on an assignment given to the students. There are four students in the class. For their senior design project, the students are building an Arduino based system to remotely measure the water level in a creek in Johnson City, Tennessee, every 5 minutes, 24/7. The assignment was to determine a good lower bound for the size (area) of a solar panel that would be needed to power the system. The students needed to state their assumptions about system parameters such as power consumption, solar panel and battery storage efficiency, and solar incidence at the creek location. They needed to develop models and introduce variables that would incorporate these parameters with engineering concepts, such as Watt's Law, in order to estimate how large, the solar panel would need to be. Although 0 is a valid mathematical lower bound on the size of the panel, the students were told that if they simply reported 0 for the lower bound they would receive a 0 for the assignment.

- Two students reported the size of the solar panel in terms of watts but didn't compute the area of the panels.
- S1, S2, S3 and S4 refer to the four individual students.
- Two rubric items are marked as N/A (Not Applicable). In the second semester of Senior Design the students will conduct experiments to validate the design approaches.

ME 3023, Spring 2022

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Identify			
Demonstrates understanding of problem scenario by developing a well-written problem/opportunity statement		3	1
Identifies problem requirements through clear statement of constraints, criteria, variables, and objectives		3	1
Identifies appropriate modeling approaches related to the engineering system		3	1
Formulate			
Subdivides complex problems into smaller, more tractable problems		4	
Simplifies complex problem into idealized model(s)		3	1
Develops appropriate math/science/engineering model		3	1
Identifies viable solution approaches		4	
Makes reasonable assumptions for models and recognizes limitations so that the appropriate one is selected for the context or application		3	1
Solve			
Selects and applies effective solution procedures/techniques/tools correctly			4
Solves math model using analytical, numerical, and/or approximate methods			4
Verifies that the solution is practical and can be implemented			4
Validates that the solution is appropriate and reasonably represents the original problem			4

Indirect Assessment Data: Senior Exit Survey

My classes improved my ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Strongly Agree	2
Agree	2
Disagree	0
Strongly Disagree	0

SO2: 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

Engineering Design: Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade- offs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

ENGR 4960, Spring 2022

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Design Considerations			
Asks design questions with respect to health, safety, welfare factors		3	
Asks design questions with respect to global, cultural, social factors		3	
Asks design questions with respect to environmental and economic factors		3	
Asks design questions with respect to codes and standards			
Identifies important design variables, documents specifications, establishes constraints, and considers implementation strategy to define solvable design space		3	
Design Process			
Demonstrates application of the steps of the engineering design process			
Develops clearly defined goals		3	
Gathers information and performs analysis and synthesis		3	
Includes steps of analysis, construction (if needed), testing, and evaluation as part of design project		3	
Formulates and documents more than one viable design to meet specified needs		3	
Evaluation			
Evaluates alternatives against requirements and considers risks and trade-offs			

Analyzes and ranks design possibilities to find "best" solution with consideration to the interdependency of the constraints		3	
Uses risk analysis to enumerate/respond to risks in product or process design		3	
Considers solution alternatives with respect to health, safety, welfare factors		3	
Considers solution alternatives with respect to global, cultural, social factors		3	
Considers solution alternatives with respect to environmental and economic factors		3	
Demonstrates use of design cycles more than once on a specified problem for refined result		3	
Design Solution and Documentation			
Fully conveys selection of final design and documentation			
		3	

Indirect Assessment Data: Senior Exit Survey

My classes improved my 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.

Strongly Agree	2
Agree	2
Disagree	0
Strongly Disagree	0

SO3: An ability to communicate effectively with a range of audiences

ENGR 4900, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Context and Purpose for Writing			
The technical content and level of detail are appropriate for audience		4	
The document provides a clear purpose and context and motivates the reader's interest in the topic		4	
Content Development			
The document addresses the stated objectives of the work		4	
The document is well-structured and organized with a logical progression from understanding of the problem or topic through research method, results, and conclusions		4	
All tables and figures or similar illustrations are referenced in the text		4	
Appendices are used effectively to provide supporting materials	4		

Sources and Evidence			
Statements are supported with a variety of credible sources: literature, experimental data, interviews, and/or other relevant sources, without plagiarism		4	
References are cited and presented in the format required		4	
Syntax and Mechanics			
The document has few to no grammatical, spelling, or punctuation, errors		4	
The document is readable, constructed from concise, clear, and correct use of language without jargon and slang		4	
The document has a consistent tense and voice		4	
All required formatting is followed, e.g., font, font size, margins		4	
Tables, figures, charts, graphics, drawings, photos, or similar visual methods communicate information effectively and are labeled well		4	
Appropriate units are used and are in the required format		4	
Math grammar is correct and appropriate		4	

The assessment was based on student performance on three homework assignments (HW3, HW5, and HW8) and a question on one exam (Exam3). Specific items assessed corresponding to this rubric included the following:

- Develop a written assessment of two similar design solutions (products) to a common problem and suggestions to improve one of the designs with consideration of life expectancy and end-of-life details and any health, safety, and welfare factors if any. This instrument (HW3) was a group assignment completed by students in pairs because part of the assignment involved brainstorming/design synthesis, which cannot be completed individually.
- Perform design analysis for a shafting system and write a design analysis report. This instrument (HW5) was a group assignment completed by students in pairs because the verification and validation work was not an individual activity.
- Develop written assessments of an ethics case study based on in class discussions that explain the ethical perspectives of several persons in different positions of responsibility and discuss engineering responsibility in terms of a code of ethics. This instrument (HW8) was completed by individuals.
- Through an exam, write discussions that assess societal, environmental, and global impacts of a larger ethics case study originally considered in class. This instrument (a question on Exam3) was completed by individuals.
- Several opportunities to work through conflict of interest and safety scenarios were included among the four instruments.
- Each performance dimension was observed; however, the student use of appendices did not meet expectations.

SO3: An ability to communicate effectively with a range of audiences

ENGR 4900, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Delivery and Engagement			
The student dresses appropriately for the presentation.		4	
The student speaks loudly enough to be heard.		4	
The student avoids “ums,” “uhs,” or other filler words and unnecessary movements.		4	

The student maintains eye contact with the audience.	1	3	
The student does not read from the presentation.			
Technical Content			
The presentation is well-organized.		3	1
The length of the presentation is appropriate for the setting.	1	2	1
The student demonstrates technical knowledge.		3	1
The student addresses questions well.		3	1
The student uses technical vocabulary appropriate for the audience.		3	1
Supporting Materials			
Correct spelling and grammar are used in the visual presentation		4	
Appropriate props, such as physical models or prototypes are used to support the presentation.		N/A	

The assessment was based on student performance on individual student presentations (HW7) about ethical issues. Specific items assessed corresponding to this rubric included the following:

- Develop a presentation based on a given mini-case study/scenario in which ethical issues must be identified/recognized and assessed in terms of economics, society, environment, and global impact.
- Answer question prompts for the scenario to demonstrate engineering judgment to resolve the ethical issues.
- Give the presentation and answer questions from the rest of the class and the instructor.
- Each dimension was observed excerpt for the use of props as props were not needed for the presentation.

Indirect Assessment Data: Senior Exit Survey

My classes improved my ability to communicate effectively with a range of audiences.

Strongly Agree	1
Agree	2
Disagree	1
Strongly Disagree	0

SO4: 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

ENGR 4900, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Ethical Issue Recognition			
Identifies key ethical issues in engineering situations taken from real life, with outcomes both good and bad		3	1
Identifies current or recent ethical cases and explains the main issues		3	1
Explains engineering responsibility for the public health, safety, and welfare as stated in a relevant engineering code of ethics		3	1

Understands conflict of interest and consequences of various actions		3	1
Application of Ethical/Professional Perspectives and Contexts			
Makes balanced engineering judgments, i.e., selects alternatives and solutions, informed by appropriate codes, standards, breadth of information		3	1
Assesses the economic impact of a solution, including identifying costs and benefits from a life-cycle perspective (evaluated in ENGR 4960)*		3	1
Assesses the societal impact of a solution, considering issues such job creation or elimination, disruption of lifestyle, culture		3	1
Assesses the environmental impact of a solution, considering issues such as waste generation and pollution, sustainability, life-cycle design with respect to materials and energy		3	1
Assesses the global impact of a solution, considering issues such as labor and material sources, laws and regulations, human rights, fair trade, geopolitical stability, culture, and language		3	1
Conducts an appropriate safety analysis, i.e., considering hazards and safety concerns		3	1

The assessment was based on student performance on two homework assignments (HW7 and HW8) and on two exams (Exam2 and Exam3). Specific items assessed corresponding to this rubric included the following:

- Develop a presentation based on a given mini-case study/scenario in which ethical issues must be identified/recognized and assessed in terms of economics, society, environment, and global impact.
- Answer question prompts for the scenario to demonstrate engineering judgment to resolve the ethical issues.
- Give the presentation and answer questions from the rest of the class and the instructor.
- Participate in the presentations of other students.
- Develop written assessments of a larger case study based on in class discussions that explain the ethical perspectives of several persons in different positions of responsibility and discuss engineering responsibility in terms of a code of ethics.
- Through one exam, write short answers and discussions to resolve ethical scenarios that specifically focus of the use of a code of ethics (ASME in this case) and the fundamental canons of the code.
- Through another exam, write discussions that assess societal, environmental, and global impacts of a larger case study originally considered in class.
- Several opportunities to work through conflict of interest and safety scenarios were included among the four instruments.

<u>Indirect Assessment Data: Senior Exit Survey</u>

My classes improved my ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, considering the impact of engineering solutions in global, economic, environmental, and societal contexts.

Strongly Agree	3
Agree	1
Disagree	0
Strongly Disagree	0

SO5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

ENGR 4510, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Communication and Team Operation			
Communicates effectively with team members	**1**	**3**	
Attends regular scheduled team meetings		**4**	
Engages and participates as a team member		**3**	**1**
Divides the workload fairly among the team		**N/A**	
Defines roles for each team member		**N/A**	
Works with team to define a decision-making process	**1**	**3**	
Project Management			
Uses project planning/scheduling methodologies and tools to manage the project		**N/A**	
Assigns and tracks project tasks and responsibilities		**2**	**2**
Documents team meetings (including discussions and attendance)		**N/A**	
Maintains organized project documentation (electronically or project notebook)		**N/A**	

- The assessments were based on students' performance in the team project. The project was the generation of an engineering contract proposal, requiring communication with an external client, creation of an engineering project proposal (in several written stages) and a final oral presentation of the proposal.
- Some of these categories are not applicable (N/A) for this course's assessment.
- The numerical value in the table represents the average number of students exhibiting the appropriate criterion for each sub category in the last two parts of the project—i.e., in the last 4 weeks of the semester.
- Anonymous peer evaluations were used by each student at the end of the Part 3 and Part 4 phases of the team project 4 timeline (last 4 weeks of semester).

Indirect Assessment Data: Senior Exit Survey

My classes improved my 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.

Strongly Agree	1
Agree	2
Disagree	1
Strongly Disagree	0

SO6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

ME 3023, Spring 2022

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Set-up			
Identifies appropriate test, data collection process, and data analysis model to conduct an experiment	1	2	1
Describes and uses general measurement process or processes appropriate for the experiment	1	1	2
References and uses appropriate standards for various test and experimental procedures			
Develops hypotheses or predictions of experimental outcomes to validate modeling assumptions and correctness of experimental methods	2		2
Checks and/or calibrates the measurement system for appropriate calibration		4	
Sets up the experiment to ensure proper lab practice, operation, and general safety		4	
Uses dimensional analysis, appropriate dimensions, and units		N/A	
Data Collection			
Troubleshoots measurement systems for non-functioning components		3	1
Uses appropriate instruments for collecting data			4
Implements proper lab practice, operation, and general safety		3	1
Maintains good technical notes of procedure and results		4	
Uses appropriate equipment, software and/or tools for data collection			4
Analysis			
Uses appropriate statistical methods and measures to minimize experimental error		N/A	
Identifies and quantifies sources of uncertainty in the data or the analysis		3	1
Validates data using other sources of information or related data		4	
Uses appropriate software and/or tools for analysis		4	
Summary and Conclusions			
Develops and supports conclusions and inferences with available data and analysis		4	
Compares experimental results to theoretical results and explains discrepancies	1	2	1
Documents in an appropriate form so that the experiment can be properly replicated	2	2	

ENGR 4960, Spring 2022

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Set-up			

Identifies appropriate test, data collection process, and data analysis model to conduct an experiment		4	
Describes and uses general measurement process or processes appropriate for the experiment		4	
References and uses appropriate standards for various test and experimental procedures		4	
Develops hypotheses or predictions of experimental outcomes to validate modeling assumptions and correctness of experimental methods			
Checks and/or calibrates the measurement system for appropriate calibration			
Sets up the experiment to ensure proper lab practice, operation, and general safety	2	2	
Uses dimensional analysis, appropriate dimensions, and units		4	
Data Collection			
Troubleshoots measurement systems for non-functioning components	1	3	
Uses appropriate instruments for collecting data			
Implements proper lab practice, operation, and general safety	1	3	
Maintains good technical notes of procedure and results	2	2	
Uses appropriate equipment, software and/or tools for data collection		4	
Analysis			
Uses appropriate statistical methods and measures to minimize experimental error	1	3	
Identifies and quantifies sources of uncertainty in the data or the analysis	1	3	
Validates data using other sources of information or related data	2	2	
Uses appropriate software and/or tools for analysis	1	3	
Summary and Conclusions			
Develops and supports conclusions and inferences with available data and analysis	1	3	
Compares experimental results to theoretical results and explains discrepancies			
Documents in an appropriate form so that the experiment can be properly replicated	2	2	

NOTE: some are evaluated in ENGR 4950 in Fall 2021

Indirect Assessment Data: Senior Exit Survey

My classes improved my ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Strongly Agree	2
Agree	2
Disagree	0

Strongly Disagree	0

SO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

ENGR 4510, Fall 2021

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Self-established Learning Goals			
Demonstrates analysis of prior learning for gaps in knowledge and skills		N/A	
Develops a plan to acquire new knowledge and skills		N/A	
Acquiring New Information			
Identifies the extent and type information needed for the problem or task at hand	1	5	
Independently conducts critical searches for references (literature and/or subject matter experts) to support/inform a topic		N/A	
Summarizes written/oral information for key concepts	1	3	2
Demonstrates the ability to assess the credibility and applicability of information sources		5	1
Learning Strategies			
Demonstrates awareness of different learning strategies		N/A	
Identifies personal strengths and weaknesses with respect to learning strategies		N/A	
Engages in professional learning experiences		6	
Applying New Information			
Demonstrates ability to use newly acquired information to solve engineering problem or apply to other engineering situation	2	2	2

The assessment was based on student performance on the term project book report and oral presentation. Specific items assessed corresponding to this rubric include the following:

- Identify the book, providing background or contest.
- Describe the intended audience for the book.
- Summarize the main points and/or story in the book.
- Critique the book's effectiveness in engaging the reader and achieving the purpose for which the book was written.
- Explain or provide a table or figure showing how the book's content is related to the content of ENGR 4510.

ENGR 4960, Spring 2022

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Self-established Learning Goals			
Demonstrates analysis of prior learning for gaps in knowledge and skills		4	
Develops a plan to acquire new knowledge and skills		4	
Acquiring New Information			
Identifies the extent and type information needed for the problem or task at hand		4	
Independently conducts critical searches for references (literature and/or subject matter experts) to support/inform a topic		4	
Summarizes written/oral information for key concepts			
Demonstrates the ability to assess the credibility and applicability of information sources			
Learning Strategies			
Demonstrates awareness of different learning strategies		4	
Identifies personal strengths and weaknesses with respect to learning strategies		4	
Engages in professional learning experiences			
Applying New Information			
Demonstrates ability to use newly acquired information to solve engineering problem or apply to other engineering situation			

Indirect Assessment Data: Senior Exit Survey

My classes improved my ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Strongly Agree	1
Agree	3
Disagree	0
Strongly Disagree	0

Modifications for Improvement:

The focus for the year was on the ABET accreditation. The following modifications are the result of the accreditation work.

The number of graduates is still small and the assessment process and metrics are still being perfected. It has been decided that until a critical number of graduates is achieved, all student outcomes will be evaluated every year according to the mapping in Appendix 1. At the time when a sufficient number of students have graduated from the program, the Academic Affairs Council will devise and implement a multi-year evaluation schedule for the student outcomes assessment.

Additional work was needed to adjust the collection of data to focus more on individual student achievement for the outcomes. When work was completed as a team, additional effort was taken to evaluation each individual student achievement in each area of the student outcome. Also, the way the rubrics are completed by each instructor was modified to show the number of individual students in each category, as opposed to just a check in a column. If needed, additional assignments were given to assure that all students were being assessed on each of the student outcomes being measured with the rubrics.

The rubrics were found to be difficult to complete. Therefore, a new format is being proposed for the next academic year. This process is underway and the next step is for the new format will be approved by the Academic Affairs Council. The updated rubrics are to be distributed to the faculty teaching the applicable courses early in the semester when the course is being delivered.

Faculty will be instructed to include the SO's being evaluated in their class on the syllabus.

In order to help facilitate the students achieving all of the necessary SO's faculty in the program will work together in a more targeted way. Faculty in the course where each student outcome is demonstrated (D), and therefore evaluated with the assessment rubric, should discuss the topics with faculty where that student outcome is being introduced (I) or reinforced (R), so that the students have sufficient background prior to the course where the demonstration/evaluation will take place. Then the Academic Affairs Council, comprised mostly of program faculty, will all participate in the evaluation of the assessment data and plan appropriate improvements.

Appendices

1. Curriculum Map
2. SO1 – Complex Problems Rubric
3. SO2 – Engineering Design Rubric
4. SO3 – Oral Communications Rubric
5. SO3 – Written Communications Rubric
6. SO4 – Ethics Rubric
7. SO5 – Teamwork Rubric
8. SO6 – Experimentation Rubric
9. SO7 – New Knowledge and Learning Strategies Rubric
10. Proposed Format for Assessment Rubrics

Appendix 1: Curriculum Map

Student Outcome		SO1	SO2	SO3	SO4	SO5	SO6	SO7
		Complex Problems	Engineering Design	Communication	Ethics and Professionalism	Teamwork and Project Management	Experimentation and Data Analysis	New Knowledge and Learning Strategies
TTU Required Course (2020-21 Catalog)	**ETSU Required Course (2020-21 Catalog)**							
CEE 3110 Mechanics of Materials	CEE 3110 Mechanics of Materials							I
COMM 2025 Fund. of Communication	COMM 2045 Intro. To Public Speaking			I				
ECE 2050 Circuits and Electronics I	ECE 2050 Circuits and Electronics I	I	I				I	
ECE 2140 Introduction to Digital Syster	ECE 2140 Introduction to Digital Systems		I	I			I	
ENGR 1110 Engineering Graphics	ENGR 1110 Engineering Graphics			I		I		I
ENGR 1120 Programming for Engineers	ENGR 1120 Programming for Engineers							I
ENGR 3020 Numerical Methods	CSC 3020 Numerical Methods	R						
ENGR 3120 Solid Modeling	ENGR 3120 Solid Modeling		D			R		
ENGR 3710 Prin. Of Engr. Economy	CEE 3710 Prin. Of Engineering Econ.		I		I			
ENGR 3720 Engineering Statistics	CEE 3720 Engineering Statistics				I		R	
ENGR 4510 Engineering Management	ENGR 4510 Engineering Management	R		D		D		D
ENGR 4750 Mechanical Engineering Lal	ENGR 4750 Mechanical Engineering Lal	R					D	
ENGR 4900 Engr. Design, Prof., & Ethics	ENGR 4900 Professionalism & Ethics	R	R	D	D	R		R
ENGR 4950 Senior Design I	ENGR 4950 Senior Design I	R	D	R	D	D	R	D
ENGR 4960 Senior Design II	ENGR 4960 Senior Design II	D	D	D	R	D		D
ME 2330 Dynamics	ME 2330 Dynamics							I
ME 3010 Materials & Processes in Mfg.	ME 3010 Materials & Processes in Engr.				I			I
ME 3023 Measurements in Mech. Sys.	ME 3023 Measurements in Mech. Sys.	D		R			D	

Updated mapping for 2022-2023 academic year.

Appendix 2: Complex Problems Rubric

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

Complex Engineering Problems: Complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts.

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Identify			
Demonstrates understanding of problem scenario by developing a well-written problem/opportunity statement			
Identifies problem requirements through clear statement of constraints, criteria, variables, and objectives			
Identifies appropriate modeling approaches related to the engineering system			
Formulate			
Subdivides complex problems into smaller, more tractable problems			
Simplifies complex problem into idealized model(s)			
Develops appropriate math/science/engineering model			
Identifies viable solution approaches			
Makes reasonable assumptions for models and recognizes limitations so that the appropriate one is selected for the context or application			
Solve			
Selects and applies effective solution procedures/techniques/tools correctly			
Solves math model using analytical, numerical, and/or approximate methods			
Verifies that the solution is practical and can be implemented			
Validates that the solution is appropriate and reasonably represents the original problem			

Appendix 3: Engineering Design Rubric

SO2: 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 Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Design Considerations			
Asks design questions with respect to health, safety, welfare factors			
Asks design questions with respect to global, cultural, social factors			
Asks design questions with respect to environmental and economic factors			
Asks design questions with respect to codes and standards			
Identifies important design variables, documents specifications, establishes constraints, and considers implementation strategy to define solvable design space			
Design Process			
Demonstrates application of the steps of the engineering design process			
Develops clearly defined goals			
Gathers information and performs analysis and synthesis			
Includes steps of analysis, construction (if needed), testing, and evaluation as part of design project			
Formulates and documents more than one viable design to meet specified needs			
Evaluation			
Evaluates alternatives against requirements and considers risks and trade-offs			
Analyzes and ranks design possibilities to find "best" solution with consideration to the interdependency of the constraints			
Uses risk analysis to enumerate/respond to risks in product or process design			
Considers solution alternatives with respect to health, safety, welfare factors			
Considers solution alternatives with respect to global, cultural, social factors			
Considers solution alternatives with respect to environmental and economic factors			
Demonstrates use of design cycles more than once on a specified problem for refined result			
Design Solution and Documentation			
Fully conveys selection of final design and documentation			

Appendix 4: Oral Communication Rubric

SO3: An ability to communicate effectively with a range of audiences

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Delivery and Engagement			
The student dresses appropriately for the presentation.			
The student speaks loudly enough to be heard.			
The student avoids "ums," "uhs," or other filler words and unnecessary movements.			
The student maintains eye contact with the audience.			
The student does not read from the presentation.			
Technical Content			
The presentation is well-organized.			
The length of the presentation is appropriate for the setting.			
The student demonstrates technical knowledge.			
The student addresses questions well.			
The student uses technical vocabulary appropriate for the audience.			
Supporting Materials			
Correct spelling and grammar are used in the visual presentation			
Appropriate props, such as physical models or prototypes are used to support the presentation.			

Appendix 5: Written Communication Rubric

SO3: An ability to communicate effectively with a range of audiences

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Context and Purpose for Writing			
The technical content and level of detail are appropriate for audience			
The document provides a clear purpose and context and motivates the reader's interest in the topic			
Content Development			
The document addresses the stated objectives of the work			
The document is well-structured and organized with a logical progression from understanding of the problem or topic through research method, results, and conclusions			
All tables and figures or similar illustrations are referenced in the text			
Appendices are used effectively to provide supporting materials			
Sources and Evidence			
Statements are supported with a variety of credible sources: literature, experimental data, interviews, and/or other relevant sources, without plagiarism			
References are cited and presented in the format required			
Syntax and Mechanics			
The document has few to no grammatical, spelling, or punctuation, errors			
The document is readable, constructed from concise, clear, and correct use of language without jargon and slang			
The document has a consistent tense and voice			
All required formatting is followed, e.g., font, font size, margins			
Tables, figures, charts, graphics, drawings, photos, or similar visual methods communicate information effectively and are labeled well			
Appropriate units are used and are in the required format			
Math grammar is correct and appropriate			

Appendix 6: Ethics Rubric

SO4: 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 Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Ethical Issue Recognition			
Identifies key ethical issues in engineering situations taken from real life, with outcomes both good and bad			
Identifies current or recent ethical cases and explains the main issues			
Explains engineering responsibility for the public health, safety, and welfare as stated in a relevant engineering code of ethics			
Understands conflict of interest and consequences of various actions			
Application of Ethical/Professional Perspectives and Contexts			
Makes balanced engineering judgments, i.e., selects alternatives and solutions, informed by appropriate codes, standards, breadth of information			
Assesses the economic impact of a solution, including identifying costs and benefits from a life-cycle perspective			
Assesses the societal impact of a solution, considering issues such job creation or elimination, disruption of lifestyle, culture			
Assesses the environmental impact of a solution, considering issues such as waste generation and pollution, sustainability, life-cycle design with respect to materials and energy			
Assesses the global impact of a solution, considering issues such as labor and material sources, laws and regulations, human rights, fair trade, geopolitical stability, culture, and language			
Conducts an appropriate safety analysis, i.e., considering hazards and safety concerns			

Appendix 7: Teamwork Rubric

SO5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Communication and Team Operation			
Communicates effectively with team members			
Attends regular scheduled team meetings			
Engages and participates as a team member			
Divides the workload fairly among the team			
Defines roles for each team member			
Works with team to define a decision-making process			
Project Management			
Uses project planning/scheduling methodologies and tools to manage the project			
Assigns and tracks project tasks and responsibilities			
Documents team meetings (including discussions and attendance)			
Maintains organized project documentation (electronically or project notebook)			

Appendix 8: Experimentation Rubric

SO6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Set-up			
Identifies appropriate test, data collection process, and data analysis model to conduct an experiment			
Describes and uses general measurement process or processes appropriate for the experiment			
References and uses appropriate standards for various test and experimental procedures			
Develops hypotheses or predictions of experimental outcomes to validate modeling assumptions and correctness of experimental methods			
Checks and/or calibrates the measurement system for appropriate calibration			
Sets up the experiment to ensure proper lab practice, operation, and general safety			
Uses dimensional analysis, appropriate dimensions, and units			
Data Collection			
Troubleshoots measurement systems for non-functioning components			
Uses appropriate instruments for collecting data			
Implements proper lab practice, operation, and general safety			
Maintains good technical notes of procedure and results			
Uses appropriate equipment, software and/or tools for data collection			
Analysis			
Uses appropriate statistical methods and measures to minimize experimental error			
Identifies and quantifies sources of uncertainty in the data or the analysis			
Validates data using other sources of information or related data			
Uses appropriate software and/or tools for analysis			
Summary and Conclusions			
Develops and supports conclusions and inferences with available data and analysis			
Compares experimental results to theoretical results and explains discrepancies			
Documents in an appropriate form so that the experiment can be properly replicated			

Appendix 9: New Knowledge and Learning Strategies Rubric

SO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Self-established Learning Goals			
Demonstrates analysis of prior learning for gaps in knowledge and skills			
Develops a plan to acquire new knowledge and skills			
Acquiring New Information			
Identifies the extent and type information needed for the problem or task at hand			
Independently conducts critical searches for references (literature and/or subject matter experts) to support/inform a topic			
Summarizes written/oral information for key concepts			
Demonstrates the ability to assess the credibility and applicability of information sources			
Learning Strategies			
Demonstrates awareness of different learning strategies			
Identifies personal strengths and weaknesses with respect to learning strategies			
Engages in professional learning experiences			
Applying New Information			
Demonstrates ability to use newly acquired information to solve engineering problem or apply to other engineering situation			

Example of proposed changes to the Assessment Rubrics for 2022 – 2023 Academic Year

Appendix 10: Proposed Format for Assessment Rubrics

This is an example for comparison to the Complex Problems Rubric showing the new format that the Academic Affairs Council is considering for use starting in academic year 2022-2023.

Performance Dimensions	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Identify			
Demonstrates understanding of problem scenario by developing a well-written problem/opportunity statement	**Discussion:**		
Identifies problem requirements through clear statement of constraints, criteria, variables, and objectives			
Identifies appropriate modeling approaches related to the engineering system			
Formulate			
Subdivides complex problems into smaller, more tractable problems	**Discussion:**		
Simplifies complex problem into idealized model(s)			
Develops appropriate math/science/engineering model			
Identifies viable solution approaches			
Makes reasonable assumptions for models and recognizes limitations so that the appropriate one is selected for the context or application			
Solve			
Selects and applies effective solution procedures/techniques/tools correctly	**Discussion:**		
Solves math model using analytical, numerical, and/or approximate methods			
Verifies that the solution is practical and can be implemented			
Validates that the solution is appropriate and reasonably represents the original problem			
Summary (Continuous Improvement Plan):			