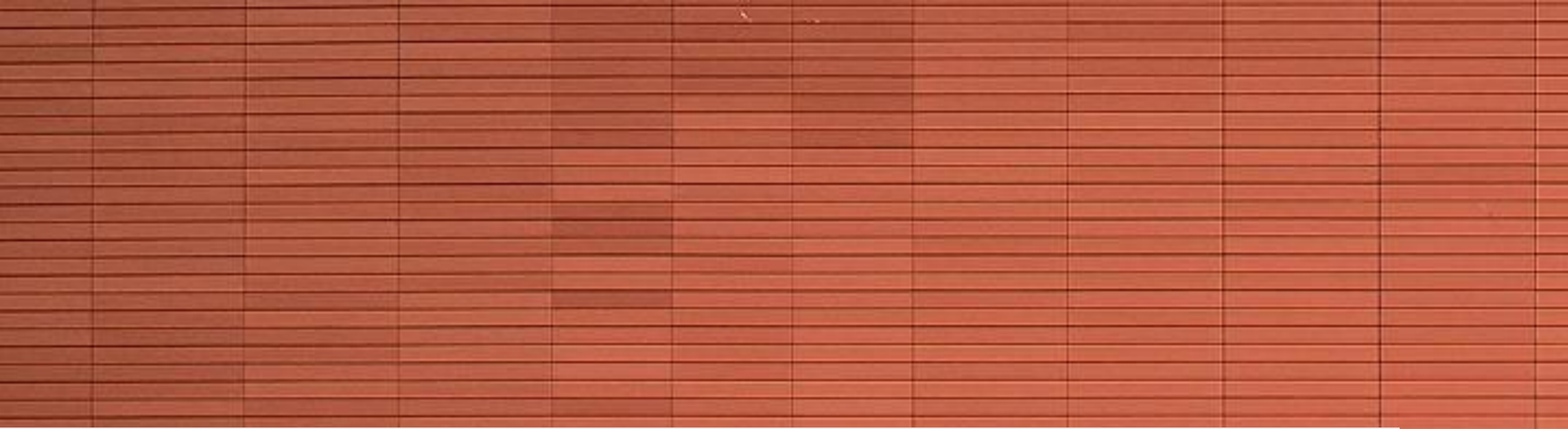

ASSESSMENT PLAN

Mechanical Eng. Program

Mechanical Engineering Department
College of Engineering & Petroleum
Kuwait University

Contents

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1 Mechanical Engineering Program's Mission, Vision, and Objectives

The Mechanical Engineering Department is committed to providing a healthy academic environment by attracting high quality students, faculty and staff. The curriculum is thoroughly based on mathematics, science, engineering science and design to fully-prepare students for their careers.

1.1 Vision

The **vision** of the program is to gain regional and international recognition for providing a quality engineering education, outstanding research programs and exceptional community service. In addition, it is envisioned that the graduates of the program will be successful in their professional careers and/or graduate studies, prepared for professional creativity and leadership, and lead productive lives that contribute to improvement of society.

1.2 Mission

The **mission** of the program is to provide a quality and broad engineering education, to conduct strong basic and applied research, and to serve the industry, the profession and the community at large through innovative solutions, dissemination of knowledge, and advancement of science and technology.

1.3 Program Educational Objectives

The **Program Educational Objectives** (PEO) are broad statements that describe what the graduates are expected to attain within a few years of graduation. It is expected that the graduates of the ME program will:

1. engage in productive careers in a broad range of mechanical engineering areas in public and private sectors in Kuwait, or successfully pursue advanced studies and careers in academia or in other research environments,
2. advance in responsibility and leadership in their careers, and engage in continuous professional development to respond to rapidly evolving technological and social challenges, and
3. contribute to the welfare of society and the development of the profession through responsible practice of engineering and involvement in professional organizations.

2 Student Outcomes

Student outcomes (SO) are the statements that describe what students are expected to know and be able to do by the time of their graduation. Achievement of all student outcomes indicates that the graduates are equipped to achieve the Program Educational Objectives. The outcomes are the same as those listed under the Criteria for Accrediting Engineering Programs, 2022-2023, which state that in preparation for professional practice, the curriculum must include:

a. principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations);
b. applications of these topics to modeling, analysis, design, and realization of physical systems, components or processes;
c. coverage of both thermal and mechanical systems; and
d. in-depth coverage of either thermal or mechanical systems.

(Source: *https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/*, accessed on May 15, 2023)

Therefore, the Student Outcomes of the Mechanical Engineering Program stipulates that its graduates shall have:

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.

The relationship between the SOs to the PEOs is mapped in Table 1.

Table 1 Relationship Between Program Educational Objectives and Student Outcomes

Mission Elements	Program Educational Objectives		
	1	2	3
University Prepare a prominent human capital characterized by their exceptional knowledge	✓	✓	
Meet the development requirements	✓		✓
Keep pace with the latest information and technology	✓	✓	
Lead in scientific research while upgrading in serving the community		✓	✓
College Provide students with quality engineering education	✓	✓	✓
Advance and disseminate knowledge	✓	✓	✓
Lead the society in enhancing its welfare		✓	✓
Department Provide a quality and broad engineering education	✓	✓	✓
Conduct strong basic and applied research	✓	✓	
Serve the industry, the profession, and community through innovative solutions, dissemination of knowledge and advancement of science and technology	✓	✓	✓

The relationship of the SOs and the curriculum is shown in Table 2, which indicates the contribution of the various courses in meeting the outcomes using the indicators *H* (high), *M* (medium), and *L* (low) as defined below:

H: "High" indicates that demonstrating this knowledge or skill in the course is critical for the overall aggregate performance of the student, i.e., it is one of the most important outcomes of the course. In teaching practice it means: 1) Provide formal instruction, 2) opportunities to develop and demonstrate the skill, and 3) formal assessment.

M: "Medium" indicates that demonstrating this knowledge or skill in the course has considerable impact on the overall aggregate performance of the student. In teaching practice it means: 1) Provide indirect instruction, 2) opportunities to develop and demonstrate the skill, and 3) formal assessment.

L: "Low" indicates that demonstrating this knowledge or skill in the course has only minor impact on the overall aggregate performance of the student. In teaching practice it means: 1) Provide opportunities to demonstrate the skill, and 2) informal assessment.

Table 2 Curriculum Contribution to Mechanical Engineering Student Outcomes (132 credits hours)

No.	Courses	Student Outcomes						
No.	General Education Requirements *(credit hours in parentheses)*	1	2	3	4	5	6	7
	Humanities & Social Science Electives (12)	-	-	L	H	-	-	L
	English Language Courses (6 Credits)	-	-	H	-	-	-	-
	Math and Basic Science Courses and Labs (27)	H	-	-	-	-	-	-
600-102	Engineering Workshop (1)	L	-	-	H	-	M	-
600-104	Engineering Graphics and Design (2)	L	L	H	-	-	-	-
600-202	Statics (3)	M	-	M	-	-	-	-
600-203	Dynamics (3)	H	-	-	-	-	-	-
600-204	Strength of Materials (3)	H	M	-	-	-	-	L
600-205	Electrical Engineering Fundamentals I (3)	H	-	-	-	-	-	H
600-207	Electrical Engineering Fundamentals I Lab. (1)	M	-	M	-	M	H	M
600-208	Engineering Thermodynamics I (3)	H	-	-	L	-	-	-
600-209	Engineering Economy (3)	H	-	-	M	-	-	-
600-304	Probability and Statistics for Engineering (3)	H	-	-	L	-	M	M
600-307	Applied Num. Methods & Prog. for Eng. (3)	H	-	-	-	M	-	L
630-241	Materials Science (3)	H	-	-	L	-	L	L
630-259	Introduction to Design (3)	L	H	H	M	H	-	M
630-311	Theory of Machines (3)	H	M	L	-	-	-	M
630-318	System Dynamics (3)	H	M	M	-	-	-	-
630-322	Thermodynamics II (3)	H	M	-	M	L	-	L
630-331	Fluid Mechanics (3)	H	L	-	-	-	-	-
630-351	Mechanical Design I (3)	H	M	-	L	-	-	L
630-353	Manufacturing Processes (3)	H	M	M	L	M	-	-
630-373	Mechanical Engineering Fundamentals Lab.	H	-	H	-	L	H	-
630-415	Mechanical Vibrations (3)	H	M	M	L	-	-	L
630-417	Control of Mechanical Systems (3)	H	H	M	-	L	-	L

No.	Courses	Student Outcomes						
No.	General Education Requirements *(credit hours in parentheses)*	1	2	3	4	5	6	7
630-421	Heat Transfer (3)	H	M	M	-	-	-	-
630-424	Air-Conditioning and Refrigeration (3)	M	H	M	M	L	-	L
630-451	Mechanical Design II (3)	H	H	M	M	L	-	M
630-455	Computer-Aided Design (3)	H	M	M	M	L	-	M
630-459	Engineering Design (3)	H	H	H	H	H	M	H
630-473	Thermal Science Laboratory I	M	-	M	L	M	H	-
630-474	Dynamics of Machines and Vibrations Lab.	H	M	H	L	M	H	-
630-475	Thermal Science Laboratory II	-	M	H	L	M	H	-
630-476	Control of Mechanical Systems Lab.	M	M	H	L	M	H	L

For each Student Outcome, the following are defined in Table 3 through Table 9:

1. **Outcome Indicators** identify the performances that the faculty will look for in order to determine whether or not a Student Outcome is met. Outcome indicators identify what concrete actions the student should be able to perform as indicators of achievement of the outcome.
2. **Implementation Strategy** lists the areas in the curriculum where the outcome is taught and student performance is measured to identify the students' strengths and weaknesses.
3. **Evaluation Methods** list the assessment instrument(s) that are used to assess student learning. It includes formative data that are collected in the initial courses of the program to determine the level at which students are demonstrating the Performance Indicators related to the Student Outcome. Formative data identify the students' strengths and weaknesses related to the student outcome; and summative data that are collected in the courses towards the end of the program to document student attainment of the outcome. These data are used to identify whether the program has attained the desired level of student performance related to the outcomes.
4. **Logistics** identifies when the assessment data will be collected.
5. **Performance Metrics** are the minimum level of acceptable performance (threshold) related to the assessment data collected.

Additionally, the **Opportunities to Demonstrate the Outcome** are provided in Appendix A. These are the educational strategies designed to provide opportunities to demonstrate the outcome for students to learn, practice, demonstrate and/or get feedback on their performance for the specific performance indicators.

Table 3 Program Assessment and Evaluation Matrix for Outcome 1

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

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Identify an engineering problem or an opportunity for an engineering solution - Formulate an engineering problem and identify opportunities for an engineering solution - Develop and validate solutions to complex engineering problems - Develop models describing the behavior of systems or processes, solve, evaluate and interpret model predictions - Obtain solutions to predict behavior of systems or processes - Evaluate and interpret model predictions	- Students apply Chemistry principles in Materials Science (ME 241) and Thermodynamics II (ME 322) - Students apply Physics principles in modeling mechanical systems, use mathematical methods (analytical and numerical) to obtain model solutions, and evaluate and interpret model predictions in various core courses, e.g., System Dynamics (ME 318), Thermodynamics II (ME 322), Fluid Mechanics (ME 331), Vibrations (ME 415), Control (ME 417), Heat Transfer (ME 421), and CAD (ME 455) - Students use Probability and Statistics in reliability design of machine components in Mechanical Design I and II (ME 351, ME 451) - Students formulate and solve complex engineering problems by isolating and describing their important components, and according to performance requirements in: *engineering and major core courses*, e.g., dynamics (ENG 203), Thermodynamics (ENG 208), Theory of Machines (ME 311),	- Exams and quizzes - Project and lab reports - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
	System Dynamics (ME 318), Fluid Mechanics (ME 331), Mechanical Design I (ME 351), Manufacturing Processes (ME 353), and in certain aspects of senior lab courses (ME 473, ME 476) Cornerstone (ME 259) and Capstone (ME 459) design courses where students work on open-ended problems and major projects			

Table 4 Program Assessment and Evaluation Matrix for 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."

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Establish objectives of a design project based on needs - Formulate the design problem based on objectives and constraints that consider public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	- In the cornerstone design course (ME 259) students are introduced to the design process through case studies and projects - In the courses Mechanical Design I (ME 351), II (ME 451) and CAD (ME 455) students are required to design mechanical components or systems using analytical and computational techniques	- Exams - Design project reports - Design prototypes - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - Capstone project reports are evaluated by a committee of 3	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Identify and apply relevant Codes and Standards - Generate ideas and alternative solutions for a given problem - Evaluate alternatives and be able to choose "the best" - Create a prototype or model that embodies or represents the chosen solution	- In the courses Heat Transfer (ME 421) and AC (ME 424), students are required to design elements of thermal systems - In the capstone design course (ME 459) students are required to design and realize mechanical engineering systems or products - In the courses Mechanical design II (ME-451), Computer Aided Design (ME-455) and Engineering Design (ME-459), students learn how to locate and use relevant codes and standards.		faculty members every semester - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	

Table 5 Program Assessment and Evaluation Matrix for Outcome 3

"An ability to communicate effectively with a range of audiences."

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Communicate effectively in written form - Communicate effectively in oral form - Communicate effectively in graphical form - Communicate effectively with a range of audiences	- In the English courses (ENGL 123) and (ENGL 221), students take oral communication and technical writing. The students get the opportunity to improve these skills further throughout the curriculum - In the cornerstone design course (ME 259) Mechanical Design II (ME 451), CAD (ME 455), capstone design course (ME 459) and in all the Labs, students are required to write essays, projects and lab reports - In the cornerstone design course (ME 259), and capstone design course (ME 459) students are required to	- Essays - Project and lab reports - Presentations - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
	customize and deliver their presentations to three different audiences: 1. Class presentation to peers (reporting their progress) 2. Technical presentation to the department (final presentation) 3. Public presentations/poster (at public exhibition) Also, in the capstone design course, the students are asked to prepare an executive summary for the "upper management"- In the cornerstone design course (ME 259), Mechanical Design II (ME 451), and capstone design course (ME 459), students are required to produce detailed drawings of their designs using the skills learned in the drawing course (ENG 104)			

Table 6 Program Assessment and Evaluation Matrix for 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."

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Demonstrate knowledge of professional codes of ethics - Evaluate various dimensions of an engineering problem/case from an ethical point-of-view - Identify possible impacts of engineering solutions in global, economic, environmental, and societal contexts - Recognize the responsibilities towards society and the environment - Identify relevant socio-political,	- In the cornerstone design course (ME 259) students are introduced to the codes of ethics through case studies and are made aware of the effects of engineering solutions on society and environment through case studies and projects - In the courses Mechanical Design I (ME 351) and CAD (ME 455) students are required to reflect on ethical issues and criteria of design solutions and projects through case studies - In the AC course (ME 424) students are exposed to current environmental and energy related issues - In the capstone design course (ME 459) students are required to identify ethical issues and generate ethical criteria within the context of their design project and are required to reflect on the impact of their	- Exams and quizzes - Essays - Project reports - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
economical or technological issues - Discuss ways engineers might contribute to solving society's problems	project outcome on the society and environment - Students take a variety of Social Science and Humanities courses that cover socio-political and other cultural issues - In Engineering Economy (ENG 209) students are exposed to impact of economy on engineering solutions and vice versa - In various required and elective courses students are required to reflect on the implications of this outcome			

Table 7 Program Assessment and Evaluation Matrix for 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."

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Recognize essential requirements of effective teams - Function effectively in teams to complete a given task - Recognize each team members' skills and abilities	- In the cornerstone design course (ME 259) students are introduced in team building skills through lectures and case studies, and are given opportunities to practice teamwork through assignments and projects - In all Labs, Engineering Fundamentals (ME 372), Thermal I (ME 473) and II (ME 475), Vibrations Lab (ME 474) and Controls Lab ME (476), students do experiments, projects and report the results in teams - In various core courses, e.g., Mechanical Design II (ME 451), CAD (ME 455), students do projects in teams - In the cornerstone and capstone design courses (ME 259, 459) and courses with group projects: students are encouraged to recognize each team members' skills and abilities by taking teambuilding skills and learning styles surveys	- Exams and quizzes - Lab and project reports - Peer evaluations - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Table 8 Program Assessment and Evaluation Matrix for Outcome 6

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

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Develop experiments or experimental procedure - Conduct experiments - Analyze and interpret experimental data	- In Science labs and in the Mechanical Engineering Fundamentals Lab (ME 373) students are introduced in conducting experiments, analyzing and interpreting experimental measurements - In senior Labs, Thermal I (ME 473) and II (ME 475), Vibrations Lab (ME 474) and Controls Lab ME (476), students conduct experiments, analyze and interpret data, as well as develop experiments to test hypotheses, demonstrate phenomena or solve open-ended problems - In the capstone design course (ME 459) students develop and implement experimental methods/procedures to test their prototypes as needed.	- Exams - Lab reports - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

Table 9 Program Assessment and Evaluation Matrix for Outcome 7

"An ability to acquire and apply new knowledge as needed, using appropriate learning strategies."

Outcome Indicators	Implementation Strategy	Evaluation Methods	Logistics	Performance Metrics
- Recognize the need for life-long learning as an essential requirement - Acquire knowledge/skills independently - Reflect on own understanding and learning	- In the cornerstone design course (ME 259) students conduct library search, have opportunities of self-learning through internet e-courses, and master topics not yet covered in the curriculum - In the Mechanical Design II course (ME 451) students are required to study mechanical and electrical components, not covered in the course but needed for a term project. They also consult references and Internet resources - In the CAD course (ME 455) students have the opportunity to learn new computer tools on their own - In the capstone design course (ME 459) students are required to work on a major project under minimum supervision. They also consult references, codes and standards, etc., on their own - Students are encouraged to join professional societies and be active in their activities - Students are encouraged to attend general lectures and seminars	- Exams and quizzes - Essays - Project reports - Exit survey	- Course assessment every semester by instructors of relevant courses using Instructor Class Evaluation Form (ICEF) - TAG evaluations of course assessments every year - Exit survey every year - Assessment coordinator analyzes and reports results to UPC every year	- Instructors of relevant courses report students' performance 60% (3) or higher on this outcome - In surveys graduates' performance is rated 60% (3) or higher on this outcome

3. Assessment Data Collection

3.1 Data Collection Frequency

The following data shall be collected for each six-year assessment cycle with the frequency and data treatment indicated:

1. Graduating Senior Exit Survey – collected at end of every semester, data is then sent to the Office of Academic Assessment for processing.
2. Membership/activity in student professional organizations – collected at end of each academic year.
3. Employer Survey – collected twice for each six-year assessment cycle collected by the Office of Academic Assessment and reported to the department.
4. Alumni Survey – collected twice for each six-year assessment cycle collected by the Office of Academic Assessment and reported to the department.
5. Faculty Survey – collected twice for each six-year assessment cycle collected by the Office of Academic Assessment and reported to the department.

Every semester all faculty members shall be required to upload the following course-related materials to the Virtual Assessment Room:

1. A softcopy of completed instructor class evaluation form ICEF) done online.
2. A copy of the list of final grades.
3. Course syllabus.
4. A copy of the Course description.
5. A copy of final exam and major term project(s).
6. Assessment tools used, e.g.: oral and written report Evaluation, teamwork, self-evaluations.
7. Samples of student works, e.g.: assignments, homework, quizzes, exams, project reports, etc.
8. Any other supporting material, e.g.: sample class portfolios, video recordings, etc.

Starting in Fall 2022/2023 academic year, the Mechanical Engineering Department adopted a sampling of specific outcomes over a three-semester cycle (a year and a half). The courses that are sampled are specified in Table 11 Semester 1: Assess Outcome 2 (design) and Outcome 5 (Teamwork), Table 10 Semester 2: Outcome 1 (problem-solving) and Outcome 7 (continuous learning), and Table 13 Semester 3: Outcome 3 (communication) and Outcome 4 (ethics) The relevant faculty members who courses are sampled shall be required to submit their course material assessment by outcome in the Virtual Assessment Room.

Starting in Fall 2023/2024 academic year, the Mechanical Engineering Department shall implement a Performance-Indicator based Student Outcome Assessment Form (SOAF) in order to better link student outcomes to evidence collected from student work.

Table 10 Semester 1: Assess Outcome 2 (design) and Outcome 5 (Teamwork)

TAG	Course No.	Course Name	2	5
Dynamics & Control	0630-417	Control of Mechanical Systems	H	L
Dynamics & Control	0630-311	Theory of Machines	M	-
Thermal Science	0630-421	Heat Transfer	M	-
Materials & Manuf	0630-353	Manufacturing Processes	M	M
Major Design	0630-259	Introduction to Design	H	H
Major Design	0630-459	Engineering Design	H	H

Table 11 Semester 2: Outcome 1 (problem-solving) and Outcome 7 (continuous learning)

TAG	Course No.	Course Name	1	7
Dynamics & Control	0630-318	System Dynamics	H	-
Materials & Manuf	0630-241	Materials Science and Metallurgy	H	L
Solid Mech & Design	0630-351	Mechanical Design I	H	L
Solid Mech & Design	0630-451	Mechanical Design II	H	M
Thermal Science	0630-322	Engineering Thermodynamics II	H	L
Major Design	0630-259	Introduction to Design	L	M
Major Design	0630-455	Computer Aided Design	H	M
Major Design	0630-459	Engineering Design	H	H

Table 12 Semester 3: Outcome 3 (communication) and Outcome 4 (ethics)

TAG	Course No.	Course Name	3	4
Dynamics & Control	0630-415	Mechanical Vibrations	M	L
Thermal Science	0630-424	Air-Conditioning and Refrigeration	M	M
Major Design	0630-259	Introduction to Design	L	M
Major Design	0630-455	Computer Aided Design	H	M
Major Design	0630-459	Engineering Design	H	H

Additionally, the laboratory courses are sampled every semester for Outcome 6 as shown in Table 13 Outcome 6: Experimentation assessed every semester for the lab courses.

Table 13 Outcome 6: Experimentation assessed every semester for the lab courses

TAG	Course No.	Course Name	6
Dynamics & Control	0630-474	Dynamics of Machines & Vibrations Lab.	H
Dynamics & Control	0630-476	Control of Mechanical Systems Lab.	H
Solid Mech & Design	0630-373	Mechanical Eng. Fundamentals Lab.	H
Thermal Science	0630-473	Thermal Science Laboratory I	H
Thermal Science	0630-475	Thermal Science Laboratory II	H

3.2 Analysis and Evaluation of Assessment Data

The Program Assessment Coordinator and the Teaching Area Group (TAG) coordinators compile and carry out the initial analysis of the assessment data. Interpretations are made to determine the extent that the performance criteria are met, based on targeted levels.

The following performance measurements shall represent attainment of the relevant Student Outcome (SO):

- The students will receive an average rating of 3 and above by the instructors on ICEF, in the courses designated to the specific outcome for program assessment
  - Lab and major design reports will receive 70% and above using relevant assessment tools.
  - Oral presentations and teamwork will receive 70% and above using relevant assessment tools.
- TAG evaluations of course assessments related to student outcomes will be positive
- The average ratings for student outcomes in surveys will be 3 and above.

The outcomes are evaluated every academic year. The achievement of the outcomes is determined according to the metrics mentioned. In the Fall Semester of each academic year the TAGs evaluate course assessment data for the previous academic year. Once these evaluations are completed, the Assessment Coordinator compiles them, along with survey results that might be available, into an Assessment Report. The report is submitted to the Undergraduate Program Committee for possible corrective actions at the course and curriculum levels.

The following performance measurements shall represent attainment of the relevant outcome for the Program Educational Objectives (PEO):

- Graduates' preparation several years after graduation, based on surveys of outcomes that are related to the objectives, will receive an average rating of 3 or more.
- The level of importance of the outcomes in surveys that are related to objectives will receive an average rating of 3 or more.
- The review of the Program Educational Objectives by the Industrial Advisory Board of the department will be positive.

The results are shared with concerned faculty and the Undergraduate Program Committee (UPC) for possible corrective actions at the course and program levels. The students are also informed about the results and recommendations via the Student Advisory Council. The results and recommendations regarding common courses are communicated to the College of Engineering & Petroleum and the College of Science via the Office of Academic Assessment.

APPENDICES

APPENDIX A Opportunities to Demonstrate Outcomes

A.1 Student Outcome 1

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

(a) An ability to identify, formulate, and solve complex engineering problems
- **Drafting skills** for creating and interpreting manufacturing and assembly drawings, including the use of CAD tools to create 2D drawings and parts lists (ME 459)
- An ability to **use CAD solid modeling** software of engineering applications including creating and assembling 3D models of simple engineering systems (ME 459).
- An ability to **write a computer program** to solve an engineering analysis or design problem (ENGR 307, ME 311, ME 318, ME 415, ME 417, ME 421, ME 455).
- An ability to **use general engineering analytical software** as a tool for solution of common engineering problems using numerical methods, vector analysis, and matrix operations (ENGR 307, ME 259, ME 318, ME 415, ME 417, ME 455). MATLAB is introduced and used in the course ME 318 (System Dynamics), ME 415 (Mechanical Vibrations), ME 417 (Control of Mechanical Systems), ME 455 (Computer-Aided Design). Special packages are used in the courses ME 331 (Fluid Mechanics), ME 421 (Heat Transfer) and ME 424 (Air-Conditioning and Refrigeration). In some courses, students are asked to use programs accompanying the textbook or to write their own programs for specific purposes. Examples of such courses are ENGR 307 (Applied Numerical Methods and Programming for Engineering), ME 311 (Theory of Machines), ME 415 (Mechanical Vibrations). All students have free access to the Internet at any time and without any limitation. They are expected to use this facility in the collection of data and information especially for the courses ME 451 (Mechanical Design II) and ME 459 (Engineering Design).
- An ability to **use finite element analysis software**, including the ability to correctly mesh a solid model, apply meaningful loads and boundary conditions, complete a stress analysis, and interpret the results (ME 455). ANSYS (or similar software) is introduced and used in the course ME 455 (Computer-Aided Design) and used in the analysis and design of thermal systems (Fluid Mechanics and Heat Transfer) and of Mechanical Systems.
- An ability to **identify the main components** of an engineering system, in order to model and simulate this system (ME 311, ME 318, ME 322, ME 351, ME 415, ME 417, ME 421, ME 424, ME 451, ME 473, ME 474, ME 475, ME 476).
- An ability to **identify modes of failure** and specify the causes and the means to remedy them (ME 351, ME 415, ME 417, ME 451, ME 474).
- An ability to **solve complex engineering problems** related to the understanding of functions of systems, to the modification of these functions, or to the improvement of behavior and quality. In general, these problems involve:
    - **modeling and simulation** of actual systems with identification of loads (ME 311, ME 318, ME 351, ME 415, ME 451),
    - **analysis of system behavior** under acting loads (equilibrium, stability, kinematics and kinetics of motion, determination of internal loads, stress, strain, and deflection analysis (ME 311, ME 318, ME 351, ME 451, ME 451),

- **analysis of energy and heat** using the first and second law of thermodynamics, irreversibility and availability analysis (ME 322),
- **selection of materials** according to their mechanical properties, based on design considerations, possible failure modes, corrosion ability and manufacturing issues (ME 241, ME 351, ME 353),
- **analysis and design of mechanisms** needed to transmit or transform motion, forces, and energy (ME 311, ME 451),
- **application of the fundamentals of fluid mechanics** (statics and dynamics) to the analysis and design of mechanical systems dealing with fluids (ME 331),
- **application of the fundamentals of thermodynamics, fluid mechanics, and heat transfer** in the analysis and design of air-conditioning systems, power plants, desalination plants, internal combustion engines, and other thermal systems (ME 322, ME 331, ME 421, ME 422, ME 424, ME 425, ME 428, ME 429, ME 473, ME 475),
- **recognition of electrical components** in a mechanical system (ENGR 205, ENGR 207),
- **analysis and design of control systems** with ability to identify the types of sensors, actuators and controllers (ME 417, ME 476),
- **Use of numerical methods, computer programming and use of standard packages** (MATLAB, Maple, Mathematica, ANSYS, COMSOL, CNC Simulator) in solving engineering problems related to analysis and design (ME 259, ME 318, ME 415, ME 417, ME 455, ME 456).

(b) Applying principles of engineering

- **Engineering Mechanics:** ENGR 202 (Statics), ENGR 203 (Dynamics), ENGR 204 (Strength of Materials) with applications in the course ME 311 (Theory of Machines), ME 318 (Systems Dynamics), ME 351 (Mechanical Design I), ME 415 (Mechanical Vibrations), ME 451 (Mechanical Design II): Modeling, equations of equilibrium, equations of motion, stress and strain, failure criteria, mechanical properties of materials.
- **Manufacturing Methods:** ENGR 102 (Workshop), ME 353 (Manufacturing Processes): Principles of manufacturing processes, including casting, metal forming, material removal, and joining, engineering and basic economic considerations.
- **Thermal Sciences:** ENGR 208 (Engineering Thermodynamics), ME 322 (Thermodynamics II), ME 421 (Heat Transfer), ME 424 (Air Conditioning and Refrigeration), ME 473 and ME 475 (Thermal Science laboratory I and II): Application of first and second laws of thermodynamics in the analysis of energy, components and systems, availability, irreversibility, power and refrigeration cycles, psychometry, combustion, design of air conditioning and refrigeration systems, power plants.
- **Materials Science:** (ME 241): Phase diagrams, microstructures, engineering materials, physical metallurgy, mechanical properties, heat treatment, ceramics, polymers.
- **Fundamentals of Electrical Engineering:** PHYS 102 and 107 (Physics II and lab), ENGR 205 and 207 (Electrical Engineering Fundamentals and lab): Electric circuits, electromagnetism machines, electronic components with applications in the courses ME 417 (Control of Mechanical Systems), ME 459 (Engineering Design).
- **Fundamental Skills in Computer Methods:** ENGR 307 (Applied Numerical Methods and Programming for Engineering): Ability to solve applied problems using numerical methods and computer programming using MATLAB, ability to use of packages of engineering and mathematics programs, such as AUTOCAD in ENGR 104 (Engineering Graphics and Design) and MATLAB in various courses such as ME 259 (Introduction to

Design), ME 318 (System Dynamics), ME 415 (Mechanical Vibrations), ME 417 (Control of Mechanical Systems). ANSYS and/or similar FE software is used in ME 455 (Computer-Aided Design). Special Programs are used in the course ME 424 (Air Conditioning and Refrigeration).

(c) Applying principles of science
- **Physics:** PHYS 101, 105 (Physics I and lab), PHYS 102, 107 (Physics II and lab) with application in the courses ENGR 203 (Dynamics), ENGR 204 (Strength of Materials), ENGR 205 and207 (Electrical Engineering Fundamentals and Lab), ENGR 208 (Thermodynamics for Engineers), ME 318 (System Dynamics), ME 415 (Mechanical Vibrations), ME 421 (Heat Transfer).
- **Chemistry**: CHEM 101 and 105 (General Chemistry I and Lab.) with applications in the courses ME 241 (Material Science), and ME 322 (Thermodynamics II).

(d) Applying principles of mathematics
- **Calculus and Analytical Geometry:** Courses MATH 101 (Calculus I) and MATH 102 (Calculus II), with applications in the courses ENGR 202 (Statics), ENGR 203 (Dynamics), ENGR 204 (Strength of Materials), ENGR 205 (Fundamentals of Electrical Engineering), ENGR 208 (Thermodynamics for Engineers), ME 318 (System Dynamics), ME 331 (Fluid Mechanics), ME 351 (Mechanical Design I), ME 415 (Mechanical Vibrations), ME 417 (Control of Mechanical Systems), ME 421 (Heat Transfer), ME 451 (Mechanical Design II).
- **Linear Algebra:** (MATH 111) and applications in the courses ME 318 (System Dynamics), ME 415 (Mechanical Vibrations), ME 417 (Control of Mechanical Systems) Matrix manipulation, solution of systems of linear equations, eigenvalues and eigenvectors.
- **Multivariate Calculus:** MATH 211 (Calculus III) with applications in the courses ME 322 (Thermodynamics II), ME 331 (Fluid Mechanics), ME 421 (Heat Transfer), ME 455 (Computer-Aided Design): Functions of functions, partial derivative, multiple integrals, optimization techniques.
- **Differential Equations:** MATH 240 (Ordinary Differential Equations) with applications in the courses ENGR 203 (Dynamics), ENGR 204 (Strength of Materials), ENGR 205 (Fundamentals of Electrical Engineering), ME 318 (System Dynamics), ME 351 (Mechanical Design I), ME 415 (Mechanical Vibrations), ME 417 (Control of Mechanical Systems), ME 451 (Mechanical Design II), ME 455 (Computer Aided Design).

A.2 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."

- **Use problem solving skills**, including the ability to convert an open-ended problem statement into a statement of work and / or a set of design specifications (ME 259, ME 415, ME 417, ME 424, ME 451, ME 455, ME 459).

- **Generate creative and feasible alternative solutions** to open-ended design problems, using precedent, lessons learned, and methods such as brainstorming or functional block diagrams (ME 259, ME 417, ME 424, ME 451, ME 455, ME 459).
- **Use common methods** such as decision matrices for comparing alternatives and making engineering decisions (ME 259, ME 455, ME 459).
- **Apply engineering analysis** (including load and stress analysis for the design/sizing of mechanical components based on likely failure modes and meaningful factors of safety and/or specified life and reliability (ME 351, ME 451, ME 455, ME 459).
- **Select machine components** (such as bearings, gears, fasteners, brakes and clutches springs, couplings) for specific purposes (ME 451, ME 459).
- **Apply useful tools for design refinement** such as value engineering, design for manufacturing and assembly, optimization techniques, or similar tools (ME 451, ME 455, ME 459)
- **Use of Finite Element Methods** for stress analysis, vibration analysis, fluid flow and heat transfer in relation with design (ME 455, ME 459)
- **Deal with engineering standards and codes**, and most of the following constraints in engineering design: health and safety, environmental, economic, manufacturability, sustainable, ethical, social, political (ME 424, ME 459).
- **Use basic manufacturing skills** (such as machining, welding, and sheet-metal operations) and the ability to work with vendors / part suppliers, technicians to build and assemble prototypes of a product design (ME 259, ME 459, ENG 102, ME 353).
- Evaluate and use test results for design improvement and validation (ME 259, ME 459).
- Design, implement, and evaluate controllers for linear systems (ME 417).
- Apply heat transfer to thermal design (ME 421, ME 424, ME 459).
- Take economic considerations into account (ENGR 209, ME 459)

<u>A.3 Student Outcome 3</u>

“An ability to communicate effectively with a range of audiences.”

a) Written and graphical communication skills appropriate to the profession of engineering, including:
- **Writing and editing clear and effective engineering design reports** including technical content that is factually correct, supported with evidence, explained with sufficient details and properly documented (ENGR 104, ENGL 123, ENGL 221, ME 259, ME 424, ME 451, ME 455, ME 459).
- **Writing and editing clear and effective laboratory reports,** including the creation of professional quality graphics for figures, tables, plots and charts (ME 373, ME 473, ME 474, ME 475, ME 476),
- **An ability to use AUTOCAD, EXCEL**, and appropriate graphical plotting packages (ENGR 104, ME 373, ME 473, ME 474, ME 475, ME 476),
- **Documenting project work** properly in a design notebook and experimental data in a lab notebook (ME 259, ME 459, and lab courses).

b) Oral and visual communication skills appropriate to the profession of engineering, including:

- **Preparing and making clear and effective formal presentations**, including the preparation of professional quality visual aids (ME 459)
- An ability to participate in technical discussions (ME 259, ME 459).

The requirements in English language for the ME Program are the same as those for other programs in the College. When new students are admitted to the College of Engineering and Petroleum, they have to pass an English aptitude test and according to their results, they are classified in one of two levels:

1. Lower Level: Students are automatically registered in the course ENGL 090 (Remedial English, 10 contact hours per week, without credit).
2. Higher Level: Students are registered in the course ENGL 123 (Intermediate Writing Skills, 5 contact hours per week, 3 credits). This course should also be taken by the "Lower Level" students after passing, with success, the course ENGL 090.

The required course ENGL 221 (Technical Writing, 3 credits) follows the course ENGL 123. Students are expected to further develop and refine written and oral communication skills in many of the required mechanical engineering courses. The course ENGL 221 is made prerequisite to the first Mechanical Engineering Laboratory course (ME 373) to ensure that this course is taken at an early stage in order to benefit subsequent courses that require written reports/laboratory and design courses). The English Language Unit (ELU) within the College of Engineering and Petroleum supervises the teaching of English language courses and is primarily responsible for developing and assuring competence in oral and written communication skills.

In the mechanical engineering laboratory sequences, students receive instruction in and exercise technical communication. A standardized format for laboratory reports has been developed for all written laboratory reports. It is publicized to students on-line through the ME Department web site. The grade assigned to the reports reflects the student's ability to explain the experiment plan, execute the experiment collect data, interpret the results, and document the relations between the results and the conclusions.

Students are also required to prepare tables, charts, and graphs that graphically communicate the results of experiments and to discuss conclusions. A sequential level of progression in technical communication instruction, maturity, and competence is involved between the sophomore and senior years. The requirements for completeness and clarity increase with each successive laboratory course.

The capstone design course ME 459 (Engineering Design) involves written communication in the form of progress and final reports and oral communication in the form of oral public presentation of the prototype during the projects exhibition and oral technical presentation and discussion of the project using visual aids and computer based techniques (Microsoft PowerPoint). A standardized format for project written reports has been developed and publicized to students. It is also used for the written report of the project of the course ME 451(Mechanical Design II).

2.4 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."

- An awareness of the NSPE (or ASME) **codes of ethics** of the engineering profession and an ability to identify the applicable professional codes of conduct for engineers such as the "Codes of Ethics for Engineers" and the "Canons of Ethics for Engineers" (ME 259, ME 351).
- An awareness of the need to consider safety and an ability to **apply methods for increasing safety** in all aspects of the engineering profession, including safety in testing, safety during manufacturing, and product safety (ME 259, ME 351, ME 451, ME 459).
- An ability to **evaluate ethical issues** that may occur in professional practice (ME 259, ME 351, ME455).
- An ability to describe the importance of **patents and intellectual property rights** (ME 259, ME 459).
    - **Interactions with industry and engineering professionals** through industrial involvement in design projects and opportunities for participation in plant tours, and professional organizations such as ASME and ASHRAE (ME 259, ME 424, ME 428, ME 429, ME 459, ASME and ASHRAE Student Chapters).
    - An ability to describe and understand the **effect of some of the contemporary issues** such as the environmental issues, global warming, water scarcity, ozone layer depletion, hydrogen economy, renewable energy, information technology, biotechnology, and nanotechnology on human life, on human values, and on the engineering profession or the practices of engineering (ME 422, ME 424, ME 428, ME 429, Social Science elective courses, seminars given by external lecturers).
    - An awareness of the **importance of transfer of new technologies** without altering the patrimonial values and traditions (general education courses, elective courses and seminars given by external speakers).
        - An awareness of the **influence of science and technology on civilizations** and an ability to explain how science and technology have been applied to the betterment of human kind. (ME 417, ME 424, ME 428, ME 429, and elective courses).
        - An ability to evaluate **the impact of energy systems** on our global society, including issues such as air pollution, climate change, and environmental regulations. (ME 422, ME 424).
            - the **impact of failure of components** on the safety of individuals and on the economy of companies and of the Country (ME 351, ME 451).
            - the **importance of respecting the natural resources** and of protecting the environment (ME 424, ME 459, and elective courses).
            - the **importance of respecting the traditions**, culture, inheritance and patrimony of the Country (ME 259, ME 459, and elective courses).
            - the **importance of correct maintenance** on the life and performance of machines and systems (ME 353, ME 451, and elective courses).

A.5 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."

Teamwork is introduced and practiced in laboratory courses, and especially, in the ME laboratory courses:

ME 373 - Fundamentals Engineering Laboratory
ME 473 - Thermal Science Laboratory I
ME 474 - Mechanical Vibrations and Dynamics of Machinery Laboratory
ME 475 - Thermal Science Laboratory II
ME 476 - Control of Mechanical Systems Laboratory

Besides the cooperation between team members, required in the laboratory work and in report writing, the senior courses contain design components that require cooperation in collecting information, in planning, in discussion of alternatives, and in execution.
All the expected abilities are developed in the design courses where students work in teams:

ME 259 - Introduction to Design
ME 451 - Mechanical Design II
ME 455 - Computer-Aided Design
ME 459 - Engineering Design

Also in all courses where projects are major parts of the courses, such as:

ME 417 - Control of Mechanical Systems
ME 424 - Air-Conditioning

Some of the elective courses require teamwork in design projects. In particular, the elective course ME 395 (Engineering Training) enables students to work in industry within multi-disciplinary teams, working on real-life engineering applications.

A.6 Student Outcome 6

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

- **Use common measurement equipment** (sensors, instrumentation, and software tools to make measurements of physical quantities), and recognize unsuccessful outcomes due to faulty equipment, parts, code, construction, process, or design and then re-engineer effective solutions.
- **Collect, analyze and interpret data**, and to form and support conclusion, make order of magnitude judgments, and know measurement unit systems and conversions.
- **Perform statistical data analysis** and curve-fittings of data sets.
- **Calculate error / uncertainty propagation** for calculations that include multiple parameters with uncertainties.
- **Apply previously-learned engineering concepts** to compare theoretical predictions with actual experimental results in diverse practical mechanical theoretical models as predictors of real world behaviors.
- **Design and plan experiments** using real-world hardware.

- **Recognize health, safety, and environmental issues** related to technological processes and activities, and activities, and deal with them responsibly.
- **Behave with high ethical standards**, including reporting information objectively and interacting with integrity.
- **Work effectively in teams**, meet deadlines and integrate individual contributions into a final report.

The number of credit hours devoted to laboratory work in the Mechanical Engineering curriculum is, at least, 10 credits. Each credit hour represents 3 hours of laboratory work per week.
Within the basic science courses, Mechanical Engineering Students take the one-credit laboratory courses:

CHEM 105	General Chemistry I Laboratory	(1 credit)
PHYS 105	Physics I Laboratory	(1 credit)
PHYS 107	Physics II Laboratory	(1 credit)

In common engineering component, the students take the courses:
ENGR 207 Electrical Engineering Fundamentals Laboratory (1 credits)

and the Mechanical Engineering Laboratory sequence:

ME 373	Mechanical Engineering Fundamentals Lab.	(2 credits, 6 hrs per wk)
ME 473	Thermal Sciences Laboratory I	(1 credit)
ME 474	Dynamics of Machines and Mechanical Vibrations Lab.	(1 credit)
ME 475	Thermal Sciences Laboratory II	(1 credit)
ME 476	Control of Mechanical Systems Laboratory	(1 credit)

In the course ME 373, experiments on simple fundamental instrumentations, measurements, calibrations, and tests related to mechanical and thermal systems are considered. MS Word, Excel, or other software are to be used in writing the reports, presenting the results in tables and drawing the graphs. A curve-fitting program is also used to represent the experimental results. Analysis of uncertainties and estimation of errors committed are also required and for some experiments, statistical analysis of the results and estimation or definition of confidence intervals is also required.

In the remaining ME Laboratory Courses, advanced experiments to observe and study specific phenomena, to measure physical constants, and to check assumptions for theoretical results are considered. Design of experiments and/or devices that can be used in experimental work is also required.

The objectives of this sequence of five ME laboratory courses are to develop students skills in planning, conducting, critically analyzing, and reporting goal-oriented experiments, to develop students' awareness of the need to express and test appropriate hypotheses, to provide students with experiments that reinforce the physical principles they have been exposed to in the course work, to extend theoretical concepts via experiments, to expand the students' understanding of the physical phenomena related to engineering practice, to provide students with the opportunity to experimentally verify mathematical models of physical systems and show the usefulness and limitations of such activity, to provide students with an opportunity to familiarize themselves with good laboratory practices and modern measurement techniques, to develop safety awareness, and to reinforce the need for excellence in written and oral communications.

The advanced laboratory courses along with the capstone design course, Engineering Design take care of developing the students' skills in experimental design. Students have to work on projects of design and manufacturing of experimental setups.

Besides the laboratory courses mentioned above, some other courses include laboratory work as integrated parts of them. This is the case of the required course ME 241 (Materials Science and Metallurgy) and the elective courses ME 416 (Noise and Vibration Control), ME 422 (Internal Combustion Engines), ME 447 (Corrosion Control for Engineering Materials), ME 449 (Nondestructive Testing), and ME 460 (Experimental Stress Analysis).

Safety considerations are explained and emphasized in all laboratory courses, and a brochure summarizing the safety procedures is distributed to all students in the first session of any laboratory course. These safety procedures are continuously recalled by the faculty and by the laboratory engineers throughout the course.

A.7 Student Outcome 7

"An ability to acquire and apply new knowledge as needed, using appropriate learning strategies."

- **An ability to find, evaluate, and use resources to learn independently** (use of library resources and of the Internet resources in the courses ME 259, ME 311, ME 451, ME 459)
- A recognition of the need to accept **personal responsibility for learning** and of the importance of life-long learning (ME 451, ME 459)
- **An ability to collect information from library and Internet resources, make independent studies and learn** independently about technical, environmental, legal aspects related to the design project (ME 259, ME 451, ME 459).

Appendix B: Instructor Course Evaluation Form (ICEF)

Course Number and Title:
Instructor:
Semester:
Number of times that you taught this course at KU:

EVALUATION METHOD	GRADING SYSTEM
______________	________
______________	________
______________	________
TOTAL	100 %

	GRADE DISTRIBUTION													
	A	A-	B+	B	B-	C+	C	C-	D+	D	F or FA	Sum	I	W
Weight (W)	4.0	3.6	3.3	3.0	2.6	2.3	2.0	1.6	1.3	1.0	0.0	-	-	-
No. of Students (N)												ΣN =		
N*W												Σ(W*N) =		

CLASS GPA = Σ (W* N) / Σ N = _________
CLASS GPA without (F or FA) = _________

Program Outcomes	**Relevance (H, M, L)**	**Performance (1-5)**	**Explanation Activities and Practices**	**Interpretation & Evidence**
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.		Rated by each instructor for their class on a scale 1-5, where: 1 is Students' performance was very weak, 2 is weak, 3 is satisfactory, 4 is very good, 5 is excellent.		
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.				

Program Outcomes	Relevance (H, M, L)	Performance (1-5)	Explanation Activities and Practices	Interpretation & Evidence
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.				

Remarks and Suggestions:

Student Outcome Assessment

Summary Evaluation of Student Outcome

Year		**Semester**	
Outcome		**Course**	
Performance indicator			
Assessment information			
Evaluation Tool used			
Summary of student performance			
Measure			
Performance			
Outcome Indicator			
Instructor's Comments			
Attachments	☐ Assessment task ☐ Grading checklist ☐ Rubric ☐ Statistical data of student performance ☐ Samples of student work ☐ Others (________________________________)		

Outcome assessment indicator based on student average

Class average for students PASSING the course	Outcome assessment indicator	Performance Level
< 60%	1	Very weak
60% - 69%	2	Weak
70% - 79%	3	Satisfactory
80% - 89%	4	Very good
> 90%	5	Excellent