

California State University, Fresno

Lyles College of Engineering

Mechanical Engineering

Department/Program Assessment Coordinator [i]: Michael Gallego Jenkins

## Student Outcomes Assessment Plan (SOAP)

### I. Mission Statement

The mission of the Department of Mechanical Engineering is to *"provide a broad-based, practice-oriented Mechanical Engineering education that enables graduates to become technically-proficient and professional leaders through innovative, entrepreneurial, multi-interdisciplinary engagement in the community and lifelong learning."*

The Bachelor of Science in Mechanical Engineering (BSME) program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>. The program has been continuously accredited since 1965.

Each accreditation period is six years and requires submission of a self study and a site visit as part of the renewal process in the fifth year of the six-year cycle. For the BSME program, accreditation is based on successful maintenance of eight Engineering Accreditation Commission (EAC) criteria (1. Students, 2. PEOs, 3. SOs, 4. CQI, 5. Curriculum, 6. Faculty, 7. Facilities, and 8. Institutional Support) and two ASME professional criteria (1. Curricular preparation for professional practice and 2. Faculty remaining current). Continuous quality improvement (CQI) addressing assessment of student outcomes (SOs) is only one of multiple criteria for maintaining accreditation.

*Note that following terms are used interchangeably: i) CSU, Fresno term Program Learning Outcome/Goal versus ABET term Program Educational Objective (PEO) and ii) CSU, Fresno term Student Learning Outcome (SLO) versus ABET term Student Outcome (SO).*

### II. Institutional Learning Outcomes, Program Learning Outcomes/Goals, and SLO's

#### A. Institutional Learning Outcomes.

Students who graduate from California State University, Fresno will demonstrate the importance of discovery, diversity, and distinction by:

1. **Developing a foundational, broad and integrative knowledge** of the humanities, the arts, the sciences, and social sciences, and their integration with their major field of study. Students will consolidate learning from different fields and explore the concepts and questions that bridge those essential areas of learning.

2. **Acquiring specialized knowledge** as identified by program learning outcomes in their major field. Students will demonstrate expertise in a specialized area of study, including integration of ideas, methods, theory and practice.
3. **Improving intellectual skills** including critical thinking, effective oral and written communication, information literacy and quantitative reasoning. Students will demonstrate fluency via application of these skills to everyday problems and complex challenges.
4. **Applying knowledge** by integrating theory, practice, and problem solving to address real world issues using both individual and team approaches. Students will apply their knowledge in a project, paper, exhibit, performance, or other appropriate demonstration that links knowledge and skills acquired at the university with those from other areas of their lives.
5. **Exemplifying equity, ethics, and engagement.** Students will form and effectively communicate their own evidence-based and reasoned views on public issues, interact with others to address social, environmental and economic challenges, apply knowledge of diversity and cultural competencies to promote equity and social justice in the classroom and the community, value the complexity of ethical decision making in a diverse society, acknowledge the importance of standards in academic and professional integrity, and demonstrate honesty, tolerance, and civility in social and academic interactions.

B. Program Learning Outcomes (a.k.a. Program Educational Objectives [PEOs]) and related SLO's (a.k.a. Student Outcomes [SOs]) ----See Table for Map of PLOs to SLOs

The alumni (within 3 to 5 years after graduation) of the Mechanical Engineering (ME) program at California State University, Fresno will:

1. PLO (PEO) Be engaged in a professional career or graduate studies using knowledge and skills obtained in their ME education;
  - a. SLO (SO 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
  - b. SLO (SO 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
  - c. SLO (SO 3) an ability to communicate effectively with a range of audiences
  - d. SLO (SO 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
  - e. SLO (SO 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
  - f. SLO (SO 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
  - g. SLO (SO 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
2. PLO (PEO) Become leaders and effective communicators actively involved in their community for the betterment of society and the profession.
  - a. SLO (SO 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

- b. SLO (SO 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
- c. SLO (SO 3) an ability to communicate effectively with a range of audiences
- d. SLO (SO 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
- e. SLO (SO 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
- f. SLO (SO 6) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Table II-1 Mapping of Program Learning Outcomes (PLOs) and Student Learning Outcomes (SLOs)

Student Learning Outcomes (SLOs) (a.k.a. Student Outcomes [SOs])	Program Learning Outcomes (PLOs) (a.k.a. Program Educational Objectives [PEOs])	
	1. Be engaged in a professional career or graduate studies using knowledge and skills obtained in their ME education	2. Become leaders and effective communicators actively involved in their community for the betterment of society and the profession.
(SO 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	●	●
(SO 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	●	●
(SO 3) an ability to communicate effectively with a range of audiences	●	●
(SO 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	●	●
(SO 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	●	●
(SO 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	●	●
(SO 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	●	●

### III. Curriculum Map: Courses in which SLOs (SOs) are addressed and evaluated

Table III-1 Contributions of ME courses to Student Learning Outcomes, SLO a) to SLO g)  
where (I = Introduced, D = Developed, M=Mastered)

Mechanical Engineering Courses		Student Learning Outcome (SLO, a.k.a. SO)						
		SO 1	SO 2	SO 3	SO 4	SO 5	SO 6	SO 7
ME 01	Introduction to Mechanical Engineering	I	I	I	I	I	I	I
ME 02	Computer Applications in ME	I	I				I	
ME 26	Engineering Graphics	D	D				D	
ME 31	Engineering Materials	D	D		D		D	D
ME 32	Engineering Materials Lab	D	D	D		D	D	D
ME 95	Product Development (Manuf Processes)	D	D	D	D	D	D I	
ME 112	Engineering Mechanics: Dynamics	D	D				D	
ME 115	Instrumentation and Measurement Lab	D	D				D	
ME 116	Fluid Mechanics.	D	D				D	
ME 118	Fluid Mechanics Lab	D	D	D		D	D	
ME 122	Dynamic Measurements & Controls (tech elective)	D	D				D	
ME 125	Engineering Statistics and Experimentation	D	D			D	D	
ME 134	Kinematics of Machinery	D			D		D	
ME 135	Senior Capstone Design I	M	M	M	M	M	M	M
ME 136	Thermodynamics	D	D				D	
ME 137	Turbomachinery (tech elective)	M	M				M	
ME 140	Advanced Engineering Analysis	D	D				D	
ME 142	Mechanical Vibrations (tech elective)	M	M				M	
ME 144	Adv Mechanics of Materials (tech elective)	M	M				M	
ME 145	Heat and Mass Transfer	M	M	M		M	M	
ME 146	Air Conditioning (tech elective)	M	M	M	M	M	M	M
ME 154	Design of Machine Elements	M	M	M	M	M	M	M
ME 155	Senior Capstone Design II	M	M	M	M	M	M	M
ME 156	Advanced Thermodynamics-Fluid Mechanics	M	M	M	M		M	
ME 159	Mechanical Engineering Lab	M	M	M	M	M	M	M
ME 162	Computer-Aided Design (tech elective)	M	M		M		M	
ME 164	Mechanical Systems Engineering Design (tech elective)	M	M				M	
ME 166	Energy Systems Design	M	M	M	M	M	M	M

**IV. SLO's Mapped to Assessment Measures and Methods [e]**

Table IV-1 Assessment Methods mapped to SLOs/SOs

Assessment Method	Student Learning Outcomes (SLOs)/Student Outcomes (SOs)						
	SO 1	SO 2	SO 3	SO 4	SO 5	SO 6	SO 7
<b>Direct Methods</b>							
Fundamentals of Engineering (FE) Examination	X	X	X		X	X	
Student Performance in Courses	X	X	X	X	X	X	X
Culminating Capstone Design Experience	X	X	X	X	X	X	X
<b>Indirect Methods</b>							
Junior Survey	X	X	X	X	X	X	X
Senior Survey	X	X	X	X	X	X	X
Course Survey	X	X	X	X	X	X	X
Senior Exit Survey	X	X	X	X	X	X	X
Co-op internship Survey	X	X	X	X	X	X	X

**V. Assessment Measures: Description of Assignment and Method (rubric, criteria, etc.) used to evaluate the assignment [f]**

- A. Direct Measures (Department/Program must use a minimum of three different direct measures)
  - 1. Fundamentals of Engineering (FE) Examination (CSU, Fresno ME student performance  $\geq$  national performance; 110 question, multi-choice exam; exam is program into subsections applied to SOs)
  - 2. Student Performance in Courses (Faculty Course Worksheet Results with 75% achievement, assessment methods vary by course and may include quizzes, exam, project reports/presentations)
  - 3. Culminating Capstone Design Experience (Faculty Course Worksheet Results with 75% achievement, assessment methods vary by course and may include quizzes, exam, project reports/presentations)
- B. Indirect Measures (Department/Program must use a minimum of one indirect measure)
  - 1. Junior Survey
  - 2. Senior Survey
  - 3. Course Survey
  - 4. Senior Exit Survey
  - 5. Co-op internship Survey

## VI. Assessment Schedule/Timeline [g]

Table VI-1 Assessment Methods Timeline

	Type	Technique	Timeline (Year)						Frequency		
			2018	2019	2020	2021	2022	2023		2024	
Goals = Program Educational Outcomes	"Indirect"	Alumni Survey	<input checked="" type="checkbox"/> (S)		<input checked="" type="checkbox"/> (S)		<input checked="" type="checkbox"/> (S)		<input checked="" type="checkbox"/> (S)	Three periods in six years	
		Employer Survey		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		Three periods in six years	
		IAC Feedback		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		Three periods in six years	
Student Learning Outcomes	"Direct"	FE Exam Results	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	Semester	
		Student Performance in Courses	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	Semester
		Culminating Capstone Design Experience	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	Annual
		Jr Survey	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	Semester
		Sr Survey	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	Semester
	"Indirect"	Course Survey	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (F) <input checked="" type="checkbox"/> (S)	Semester
		Sr Exit Interview	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	<input checked="" type="checkbox"/> (S)	Annual
		Co-op/Intern Survey		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)		<input checked="" type="checkbox"/> (F)	Three periods in six years

## VII. Closing the Loop [h,j,k]

Fresno State Closing the Loop process is described immediately below.

**A major assessment report, which focuses on assessment activities carried out the previous academic year, is submitted in September of each academic year and evaluated by the Learning Assessment Team and Director of Assessment at Fresno State.**

Program/Department Closing the Loop process:

- 1) Annually, at the beginning of each academic year (e.g., Department retreat or a Curriculum meeting of the faculty, faculty review the assessment results to determine any curricular issues that need to be addressed for the BSME program, usually in that academic year.
- 2) Annually, at one of semi-annual meeting of the Industrial Advisory Committee (IAC), the PEOs and SOs for the program are presented, reviewed and discussed for relevancy and effectiveness.
- 3) Annually, at the senior exit interview, effectiveness of the program in light of the courses, PEOs and SOs.
- 4) Every six years, the BSME program undergoes a national reaccreditation through ABET (Accreditation Board for Engineering and Technology). Reaccreditation requires the compilation

and submission of a major self-study in the early summer of the accreditation calendar year followed by a campus visit by an accreditation team on the fall of the same year.

- 5) Consistent with the six-year, national accreditation cycle, the BSME Program undergoes a Program review at the university level to evaluate if it is meeting institutional requirements.