Assessment Plan of Program Learning Outcomes

BSc Mechanical Engineering Program

Department of Mechanical Engineering

College of Engineering

King Khalid University

Academic Year 2023-2026

Contents

1. Introduction

The Mechanical Engineering (ME) Program is committed to high standards of quality in assessment and evaluation of the program and student performances since its establishment. A set of program Key Performance Indicators specified by National Centre for Academic Evaluation and Accreditation (NCAAA) are used to evaluate the quality of the program through direct and indirect measurements. The student performances are evaluated through the results and attainment of Program Learning Outcomes (PLOs) and graduation characteristics specified by NCAAA. The assessment and evaluation process of PLOs is done through the academic evaluation of the courses taught in every semester. The instructors are responsible for defining the Course Learning Outcomes (CLOs) for their courses based on the approved Course Specifications. By judging the students' achievement of CLOs at the end of the course, the strengths are identified and actions for improvement are recommended through the unachieved CLOs of their courses Furthermore, exit surveys are carried out to get feedback from the students to establish a base for improving the teaching and learning experience in ME program. Additionally, samples of student' works and results are archived and are consistently reviewed by the department's Quality Committee whose role is to help the instructors improve the quality of teaching and learning experience in their courses. For the purpose of continuous improvement, the ME program adopted direct and indirect assessment tools to evaluate the PLOs. These tools are used to collect the data necessary for evaluating the achievement level of PLOs. Evaluation, in the form of interpreting the data, is then carried out in order to determine how well the outcomes are being attained by verifying the specified target for each PLOs. The results of both the assessment and evaluation processes are finally utilized for the continuous improvement of the program. The Assessment Plan of PLOs is based on the requirements of the NCAAA to evaluate the program mission through program objectives by measuring the extent of the achievement of PLOs.

2. Vision, Mission, Program Outcomes, and Learning Outcomes

a. King Khalid University Vision

To be a world-class university in developing the human, the place and enhancing the economy

b. King Khalid University Mission

To have an academic environment stimulating the production and application of knowledge, research, and innovation, promoting social responsibility, and contributing to sustainable development by optimizing our capabilities and resources.

c. College of Engineering Vision

To be a pioneer in engineering education, innovative research, and sustainable development of the community.

d. College of Engineering Mission

To achieve academic excellence by providing adequate teaching-learning resources, motivating scientific research, and bring forth qualified engineers to serve the community.

e. Mechanical Engineering Program Vision

Achieving academic and technological leadership in the field of Mechanical Engineering, contributing through academics and applied research, and participating in the development of society.

f. Program Mission

To prepare qualified mechanical engineers who are able to develop, innovate and compete in their professions, besides involving in scientific research and community services.

g. Program Objectives

PO-1 To be creative, distinctive, and capable of running industrial establishments.

PO-2 To pursue their personal skills and professional development through continuous learning.

PO-3 To apply their academics and conduct research in the field of Mechanical Engineering.

PO-4 To effectively participate in the sustainable development of the community.

3. Consistency of the POs with the KKU'/College/Program mission

Program Mission keywords / Mission keywords		To prepare qualified mechanical engineers	able to develop, innovate and compete in their professions	involving in scientific research	involving in community services.
University Mission					
production and application of knowledge		H	H	M	M
optimizing capabilities and resources.		H	H	M	M
research, and innovation,		H	H	H	M
promoting social responsibility and contributing to sustainable development		H	H	M	H
College Mission					
Providing adequate teaching		H	H	M	M
Providing adequate learning resources		H	H	M	M
Motivating scientific research		H	H	H	M
Bring forth qualified engineers to serve the community		H	H	M	H
Program Outcomes					
P0-01	To be creative, distinctive, and capable of running industrial establishments.	H	H	M	M
P0-02	To pursue their personal skills and professional development through continuous learning.	H	H	M	M
P0-03	To apply their academics and conduct research in the field of Mechanical Engineering.	H	H	H	M
P0-04	To effectively participate in the sustainable development of the community.	H	H	M	H

H=High; M=Medium

4. Program Learning Outcomes

Knowledge and understanding	
PLO1.1	Identify integrated knowledge of engineering, mathematics, and natural sciences to solve complex problems.
PLO1.2	Describe solutions for complex engineering problems using specialized, up-to-date knowledge, while addressing public welfare, sustainability, economic factors, and real-world constraints in compliance with standards and codes.
PLO1.3	State complex engineering problems through experiments and data analysis, applying deep knowledge of materials, techniques, and practices to reach valid conclusions.
PLO1.4	Define sustainability, economic, environmental, political, health, safety, and societal factors in solving complex engineering problems.
K...	
Skills	
PLO 2.1	Apply engineering, mathematical, and scientific principles to solve complex mechanical engineering problems and validate solutions across diverse professional contexts.
PLO 2.2	Develop creative, standards-compliant solutions to complex problems by applying critical thinking across diverse professional contexts with real-world constraints.
PLO 2.3	Investigate complex problems by executing experiments, analyzing data, interpret results, and applying engineering judgment, while effectively using advanced tools, techniques, and materials in practical contexts.
PLO 2.4	Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyze data, and support research and projects by knowing their limitations.
PLO 2.5	Execute sustainability, economic, environmental, political, health, safety, and societal factors to solve complex problems across diverse disciplines and mechanical engineering professional contexts.
PLO 2.6	Apply project management, economic, and decision-making techniques while conducting research and investigations into complex problems.
PLO 2.7	Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.
S...	
Values, Autonomy, and Responsibility	
PLO 3.1	Uphold ethical, professional, and academic standards in engineering practice, making informed judgments while demonstrating responsible citizenship and respectful collaboration.
PLO 3.2	Lead and collaborate in multidisciplinary teams by applying project management, economic, and decision-making strategies, while responsibly conducting research and guiding team planning and evaluation.
PLO 3.3	Pursue lifelong learning through effective strategies to acquire and apply knowledge, while actively contributing to the advancement of the mechanical engineering discipline and society.

5. Mapping Between POs and PLOs

			Program Objectives			
	NQF Domain	PLO Code	Creative, distinctive, and capable	Continuous learning	Academic Research	Community services
Program Learning Outcomes	K	1.1	✓	✓		
		1.2	✓	✓		
		1.3	✓	✓		
		1.4	✓	✓		
	S	2.1	✓			
		2.2	✓			
		2.3	✓		✓	
		2.4	✓	✓		
		2.5	✓	✓		
		2.6	✓		✓	✓
		2.7	✓		✓	✓
	V	3.1		✓		✓
		3.2		✓	✓	✓
		3.3		✓		✓

For achieving the mission of ME program, the program educational objectives/POs are regularly reviewed and revised by various stakeholders like faculty members, advisory board members, and quality committee members. The Mechanical Engineering Program at King Khalid University prepares the graduates to have strong foundation in the multidisciplinary fields related to Mechanical Engineering. The program outcomes (PO) are defined well in such a way that it can be measured through the outcomes specified by NCAAA. POs are measured through different courses as defined in the curriculum. The PO measurement is done through appropriate Course Learning Outcomes specified in a course satisfying the student outcomes for the program (PLOs). CLO measurement is done through various assessment methods by following various learning and teaching strategy for each course.

6. PLO Distribution over Program Courses

The program learning outcomes is aligned with each program courses, according to the following desired levels of performance (I = Introduced P = Practiced M = Mastered) to ensure sequential learning

Course code & No.	Program Learning Outcomes													
	Knowledge and understanding				Skills							Values, Autonomy, and Responsibility		
	PLO 1.1	PLO 1.2	PLO 1.3	PLO 1.4	PLO 2.1	PLO 2.2	PLO 2.3	PLO 2.4	PLO 2.5	PLO 2.6	PLO 2.7	PLO 3.1	PLO 3.2	PLO 3.3
Core Courses														
107 CHEM-4	I	I			I		I				I		I	
119 MATH-3	I	I	I		I	I	I					I	I	
129 PHYS-4	I	I			I	I	I							
219 MATH-3	I	I	I		I	I	I				I	I	I	
111-GE-3	I						I							
211-ME-3	P				P		P							
212-ME-2	I	I			I									
219 PHYS-4	I	I	I		I	I	I				I	I	I	
229 MATH-3	I	I	I		I	I	I				I	I	I	
221-GE-2		I												I
221-ME-3	P				P									
222-GE-2	I							I					I	I
222-ME-3	P		P		P					I				
223-ME-3	P				P	P								
319 MATH-3	P	P			P	P	P				P	P	P	
218-EE-3	I				I	I	I	I						
301 NGL-2											I			
311-ME-3	P						P						P	
312-ME-3	P								P					P
313-ME-2		I			I	I							I	
329 MATH-3	P				P	P	P				P	P	P	
321-ME-3	P	P			P	P								
322-ME-3	P		P				P							
328-EE-3	P				P	P								P
329 STAT-2	I	I	I		I	I	I				I	I	I	
ME400-0						P	P					P		
419 MATH-3	P	P			P	P	P				P	P	P	
411-GE-2				I								I		

Course code & No.	Program Learning Outcomes													
	Knowledge and understanding				Skills							Values, Autonomy, and Responsibility		
	PLO 1.1	PLO 1.2	PLO 1.3	PLO 1.4	PLO 2.1	PLO 2.2	PLO 2.3	PLO 2.4	PLO 2.5	PLO 2.6	PLO 2.7	PLO 3.1	PLO 3.2	PLO 3.3
411-ME-3	P			P	P									P
412-ME-3	P			P									P	
413-ME-3	P		P				P							
414-ME-2	P		P	P	P									P
421-ME-3					M	M	M							
422-ME-3			M		M		M							
423-ME-3	M	M	M		M		M							
424-ME-3	M		M		M	M								
311-INE-2				I	I				I	I				
511-GE-2					M	M			M	M		M		M
511-ME-3	M				M								M	
573ME-4		M		M	M	M	M	M	M	M	M	M	M	M
411-INE-2	M					M	M							
ELECTIVE COURSES														
531-ME-3	M		M		M									
532-ME-3		M	M			M					M			
533-ME-3	M		M	M									M	
541-ME-3	M	M	M											
542-ME-3	M	M				M					M		M	
543-ME-3	M			M	M		M							
534-ME-3	M						M						M	
535-ME-3	M				M		M							
536-ME-3	M			M	M	M							M	
544-ME-3	M				M		M							
545-ME-3	M				M	M								
546-ME-3	M				M									
321-GE-2	P	P								P			P	
322-GE-2	P			P		P							P	
323-GE-2	P		P				P							

7. Assessment Methods of PLOs

a. Direct Assessments

Direct assessment is made through the measurement of student outcomes measured through a few selected courses to avoid aggregation. For each course learning outcomes are defined to satisfy the applicable student outcomes. The CLOs are measured by the course instructor through different assessment strategies specified within a course to satisfy different teaching and learning strategies. Table shows a few selected courses for the direct assessment of PLOs in the first semester. (TERM-1). Each semester these values are assessed and the average of each outcome is obtained to understand the attainment of Program objectives towards achieving the program mission.

PLO Code		NQF Learning Domains and Learning Outcomes	Assessment Strategies
Knowledge and Understanding	PLO1.1	Identify integrated knowledge of engineering, mathematics, and natural sciences to solve complex problems.	• Periodic tests • questions during the lecture • discussion in the area concerned • Assignments • Quizzes • Viva
	PLO1.2	Describe solutions for complex engineering problems using specialized, up-to-date knowledge, while addressing public welfare, sustainability, economic factors, and real-world constraints in compliance with standards and codes.	
	PLO1.3	State complex engineering problems through experiments and data analysis, applying deep knowledge of materials, techniques, and practices to reach valid conclusions.	
	PLO1.4	Define sustainability, economic, environmental, political, health, safety, and societal factors in solving complex engineering problems.	
Skills	PLO 2.1	Apply engineering, mathematical, and scientific principles to solve complex mechanical engineering problems and validate solutions across diverse professional contexts.	• Periodic tests • questions during the lecture
	PLO 2.2	Develop creative, standard-compliant solutions to complex problems by applying critical thinking across diverse professional contexts with real-world constraints.	

PLO Code		NQF Learning Domains and Learning Outcomes	Assessment Strategies
	PLO 2.3	Investigate complex problems by executing experiments, analyzing data, interpreting results, and applying engineering judgment, while effectively using advanced tools, techniques, and materials in practical contexts.	• discussion in the concerned area • Assignments • Quizzes • Demonstration • Presentations • Seminars • Viva
	PLO 2.4	Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyze data, and support research and projects by knowing their limitations.	
	PLO 2.5	Execute sustainability, economic, environmental, political, health, safety, and societal factors to solve complex problems across diverse disciplines and mechanical engineering professional contexts.	
	PLO 2.6	Apply project management, economic, and decision-making techniques while conducting research and investigations into complex problems.	
	PLO 2.7	Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.	
Values, Autonomy, and Responsibility	PLO 3.1	Uphold ethical, professional, and academic standards in engineering practice, making informed judgments while demonstrating responsible citizenship and respectful collaboration.	• interaction during the lecture • discussion on relevant topics • reports • Assignments • Viva
	PLO 3.2	Lead and collaborate in multidisciplinary teams by applying project management, economic, and decision-making strategies, while responsibly conducting research and guiding team planning and evaluation.	
	PLO 3.3	Pursue lifelong learning through effective strategies to acquire and apply knowledge, while actively contributing to the advancement of the mechanical engineering discipline and society.	

b. Indirect Assessments

Indirect assessment is made through the measurement of student satisfaction measured through course evaluation surveys. For each course surveys are made to understand the achievement of applicable program learning outcomes. In addition, this survey is conducted among students and alumni to determine their perceptions of their accomplishment of the outcomes. To ensure a 100% response rate, senior students must complete a survey when they apply for graduation. Survey questionnaire are made to understand the satisfaction of their quality of learning through the specified learning outcomes. The surveys analyzed by the quality committee at the end of every semester and feedback is given to the faculty members in the department council. An action plan is made to satisfy the appropriate target in the succeeding semester.

8. Rubrics Used for PLO Measurement

Each student outcome has a few Key performance indicators which are measured through different assessment strategies specified in a course. The rubrics specifies the level of achievement of each KPI on a 5-point scale; where level 5, 3, 1 means the performance of student is satisfactory, developing, and unsatisfactory respectively. The rubrics (the table under each Key Learning Outcome) helps the instructor to understand the weakness and recommend the actions based on the student performance.

Rubric for KLO1 (SO-1): Complex Engineering Problem Solving

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO1	Identify, formulate, solve complex engineering problems using principles of engineering sciences, mathematics, and natural sciences, and to validate the obtained solution.	**SO-1**	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 1.1: Problem Identification and Formulation **PLO1.1 Identify integrated knowledge of engineering, mathematics, and natural sciences to solve complex problems.**	Lacking problem formulation Missing key variables Lacking constraints Lacking assumptions	Weak problem formulation Missing some key variables Lacking some constraints Lacking some assumptions	Complete and satisfactory problem formulation Key issues / variables identified All relevant constraints are identified All relevant assumptions are made	Exams Assignments Projects Report Presentation
PI 1.2: Solve Complex	Alternative solutions are not presented	Alternative solutions are partially presented	Alternative solutions are clearly presented	Exams Assignments

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
Engineering Problem **PLO1.2 Describe solutions for complex engineering problems using specialized, up-to-date knowledge, while addressing public welfare, sustainability, economic factors, and real-world constraints in compliance with standards and codes.**	Constraints are ignored Arbitrary choices for final solution are made Problem not broken down into several smaller, interconnected issues Lacks validation of the obtained solution.	A few constraints are ignored Some arbitrary choices for final solution are made Problem not broken down into several smaller, interconnected issues inappropriately Validate the obtained solution to some extent	Constraints are explicitly defined Choices for final solution are made logically Problem appropriately broken down into several smaller, interconnected issues Appropriate validation of the obtained solution	Projects Reports
PI 1.3: Application of Engineering Principles and Theoretical Concept **PLO 2.1 Apply engineering, mathematical, and scientific principles to solve complex mechanical engineering problems and validate solutions across diverse professional contexts.**	Fails to apply engineering principles and theoretical concept correctly	Applies engineering principles and theoretical concept with some errors	Applies engineering principles and theoretical concept accurately and effectively	Exams Quizzes Assignments Projects Reports

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 1.4: Application of Science and Mathematics **PLO 2.1 Apply engineering, mathematical, and scientific principles to solve complex mechanical engineering problems and validate solutions across diverse professional contexts.**	Fails to apply scientific and mathematical principles correctly	Applies scientific and mathematical principles with some errors	Applies scientific and mathematical principles accurately and effectively	Exams Quizzes Assignments Projects Reports

Rubric for KLO2 (SO-2): Engineering Design

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO2	Design solutions for complex engineering problems that meet specified needs with consideration for public health, safety, welfare, and environmental, sustainability, and economic factors, as well as other realistic constraints related to the design solution, while complying with relevant standards and design codes	**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

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 2.1: Problem Definition and Needs Identification **PLO 1.1: Identify integrated knowledge of engineering, mathematics, and natural sciences to solve complex problems**	Fails to define the problem and identify needs accurately	Partially defines the problem and identifies needs but misses key aspects	Clearly and comprehensively defines the problem and identifies all specified needs	Exams Assignments Projects
PI 2.2: Consideration of Public Health, Safety, and Welfare **PLO 1.4: Define sustainability, economic, environmental, political, health,**	Fails to consider public health, safety, and welfare in the design	Considers public health, safety, and welfare but with significant gaps	Fully integrates public health, safety, and welfare considerations into the design	Exams Quizzes Assignments Projects Presentations Seminars

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
safety, and societal factors in solving complex engineering problems.				Reports
PI 2.3: Global, Cultural and Social Considerations **PLO 1.4: Define sustainability, economic, environmental, political, health, safety, and societal factors in solving complex engineering problems.**	Fails to consider global, cultural, and social factors in the design	Considers global, cultural, and social factors but with significant gaps	Fully integrates global, cultural, and social considerations into the design	Exams Quizzes Assignments Projects Presentations Seminars Reports
PI 2.4: Environmental Considerations **PLO 1.4: Define sustainability, economic, environmental, political, health, safety, and societal factors in solving complex engineering problems.**	Fails to consider environmental factors in the design	Considers environmental factors but with significant gaps	Fully integrates environmental considerations into the design	Exams Quizzes Assignments Projects Presentations Seminars Reports
PI 2.5: Economic Considerations **PLO 1.2: Describe solutions for**	Fails to consider economic factors in the design	Considers economic factors but with significant gaps	Fully integrates economic considerations into the design	Exams Quizzes Assignments

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
complex engineering problems using specialized, up-to-date knowledge, while addressing public welfare, sustainability, economic factors, and real-world constraints in compliance with standards and codes.				Projects Presentations Seminars Reports
PI 2.6: Prototype or Model Development, Testing (following standards), and Analysis **PLO 2.2: Develop creative, standards-compliant solutions to complex problems by applying critical thinking across diverse professional contexts with real-world constraints.**	Fails to develop prototypes or Study does not follow standards and codes Model Shows weakness in Testing, and Analysis	Builds an inappropriate model or a prototype partially functional. Study partially used standards and codes Shows some gaps in testing and analysing the performance	Builds a well-developed prototype or a model Study appropriately used standards and codes Fully analyses the performance based on testing	Exams Assignments Projects Poster presentation

Rubric for KLO3 (SO- 6) : Experimentation and Data Analysis

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO3	Conduct investigations of complex engineering problems through developing and executing relevant experiments, and analysing and interpreting data, supported by engineering judgment to achieve valid conclusions.	**SO-6**	an ability to develop and conduct appropriate experimentation, analyse, and interpret data, and use engineering judgment to draw conclusions.

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 6.1: Design and Conduct Experiments **PLO2.3: Investigate complex problems by executing experiments, analysing data, interpret results, and applying engineering judgment, while effectively using advanced tools, techniques, and materials in practical contexts**	Fails to design an experiment that addresses the problem Fails to conduct experiments correctly Significant procedural errors	Designs an experiment with significant gaps or flaws Conducts experiments with some procedural errors and inconsistencies	Designs a comprehensive and effective experiment that fully addresses the problem Conducts experiments accurately, consistently following proper procedures	Lab works Assignments Projects Reports

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 6.2: Data Collection and Analysis **PLO1.3: State complex engineering problems through experiments and data analysis, applying deep knowledge of materials, techniques, and practices to reach valid conclusions.**	Fails to collect relevant and accurate data Fails to analyse data correctly Significant errors in interpretation	Collects data with some inaccuracies or irrelevant aspects Analyses data with some errors or misinterpretations	Collects highly relevant and accurate data thoroughly Analyses data accurately and effectively, drawing correct interpretations	Lab works Assignments Projects Reports
PI 6.3: Interpretation of Theoretical Concepts and Experimental Results **PLO2.3: Investigate complex problems by executing experiments, analysing data, interpret results, and applying engineering judgment, while effectively using advanced tools, techniques, and materials in practical contexts**	Fails to interpret theoretical concepts and experimental results correctly; conclusions are inaccurate	Interprets theoretical concepts and experimental results with some inaccuracies; conclusions are not well-supported	Interprets theoretical concepts and experimental results accurately and effectively, drawing well-supported conclusions	Lab works Assignments Projects Reports

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 6.4: Use of Engineering Judgment (Explain observed differences between model and experiment and draw conclusions) **PLO2.3: Investigate complex problems by executing experiments, analysing data, interpret results, and applying engineering judgment, while effectively using advanced tools, techniques, and materials in practical contexts**	Fails to use engineering judgment in drawing conclusions Differences and errors are not identified or are incorrectly explained Conclusions are not justified	Uses engineering judgment inconsistently or with significant errors Most differences or errors are partially identified, and are poorly explained Conclusions are weakly justified	Uses engineering judgment accurately and consistently to draw sound conclusions All relevant differences and errors have been identified and appropriately explained Conclusions are fully justified by rigorous analysis	Lab works Assignments Projects Reports

Rubric for KLO4: Use of Modern Tools

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO4	Create, select, adapt, and apply appropriate techniques, resources and modern engineering and IT tools to solve complex engineering problems with understanding of the limitations.	-	-

PLOs/Criteria	Non-Satisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
KLO4.1: Create and Select Techniques and Tools **PLO2.4 Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyse data, and support research and projects by knowing their limitations.**	Unable to create or select appropriate techniques or tools Selection is arbitrary or irrelevant	Create or selects partially relevant techniques or tools Shows some alignment with the problem but lacks justification	Create or selects appropriate techniques and tools Provides sound justification for choices	Projects Case Studies Lab works Quizzes Exams
KLO4.2: Application and Adaptation **PLO2.4 Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyse data, and**	Misapplies or fails to adapt tools or techniques Does not consider specific problem contexts for solving complex engineering problems	Applies tools or techniques with limited adaptation Partially considers specific problem contexts for solving complex engineering problems	Effectively applies and adapts tools or techniques to specific problem contexts Demonstrates thorough understanding of contexts for solving complex engineering problems	Projects Case Studies Lab works Quizzes Exams

PLOs/Criteria	Non-Satisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
support research and projects by knowing their limitations.				
KLO4.3: Use of Modern Engineering and IT Tools **PLO2.4 Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyse data, and support research and projects by knowing their limitations.**	Demonstrates poor understanding or usage of tools Fails to use them effectively to solve problems	Uses modern tools with moderate effectiveness	Uses modern tools effectively	Projects Case Studies Lab works Quizzes Exams
KLO4.4: Understanding Limitations of Tools and Techniques **PLO2.4 Apply and adapt modern engineering, IT, and digital tools to solve complex problems, analyse data, and support research and projects by knowing their limitations.**	Lacks awareness of tool or technique limitations	Shows partial awareness of limitations	Demonstrates strong awareness of limitations	Projects Case Studies Lab works Quizzes Exams

Rubric for KLO5 (SO-4): Ethical and Professional Responsibilities

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO5	Identify and evaluate the issues and constraints of sustainability, economy, environment, politics, health and safety, and society that are relevant to professional solving of complex engineering problems.	**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.

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 4.1: Identify the Global, Politics, Health, and Safety, Economic, Environmental, and Societal Context of an Engineering Situation **PLO1.4: Define sustainability, economic, environmental, political, health, safety, and societal factors in solving complex engineering problems.**	Unable to identify any of the relevant contexts of the problem	Only a few relevant contexts are identified	Most of the relevant contexts are appropriately identified	Exams Quizzes Assignments Projects Presentations Seminars Reports
PI 4.3: Explain the Impact of Engineering Decisions in a Global, Economic, Environmental,	Explanation of relevant impacts of engineering decisions are absent or limited	Partial explanation of relevant impacts of engineering decisions	Explanation of relevant impacts of engineering decisions is substantive in all contexts	Exams Assignments Projects Presentations

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
and Societal Context. **PLO2.5:** **Execute sustainability, economic, environmental, political, health, safety, and societal factors to solve complex problems across diverse disciplines and mechanical engineering professional contexts.**				Seminars Reports

Rubric for KLO6 (SO-4): Ethical and Professional Responsibilities

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO6	Recognize ethical and professional responsibilities in engineering situations and commit to the professional ethics and norms of engineering practice to make informed judgments	**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.

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 4.2: Describe Ethical and Professional Responsibilities Related to an Engineering Project **PLO 3.1 Uphold ethical, professional, and academic standards in engineering practice, making informed judgments while demonstrating responsible citizenship and respectful collaboration.**	Description of ethical and professional responsibilities are missing or limited	Description of ethical and professional responsibilities is inappropriate	Description of ethical and professional responsibilities is complete and thorough	Exams Assignments Projects Reports
PI 4.4: Making Informed Judgments	Fails to make informed	Makes judgments with weak	Makes well-informed judgments with strong justification and	Exams Projects

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PLO 3.1 Uphold ethical, professional, and academic standards in engineering practice, making informed judgments while demonstrating responsible citizenship and respectful collaboration.	judgments; lacks justification	justification and limited evidence	comprehensive evidence	Presentations Seminars Reports

Rubric for KLO7 (SO- 5): Teamwork

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO7	Apply modern project management techniques, economic and decision-making techniques, and to work effectively as a member or leader in teams, preferably in a multidisciplinary setting.	**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.

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 5.1: Collaboration and Inclusivity in multidisciplinary setting (Teamwork) **PLO 3.2: Lead and collaborate in multidisciplinary teams by applying project management, economic, and decision-making strategies, while responsibly conducting research and guiding team planning and evaluation**	Fails to collaborate effectively Works in isolation Fails to create an inclusive environment may exclude others	Collaborates but with limited effectiveness Occasional isolation Attempts to create an inclusive environment but with limited success	Consistently collaborates effectively, fully engaging with all team members Consistently creates a collaborative and inclusive environment, ensuring all voices are heard	Projects Presentations Seminars Reports Lab works
PI 5.2: Individual responsibility and leadership	Does not complete individual tasks timely	Completes small number of individual tasks timely	Completes all the individual tasks timely	Projects Presentations Seminars

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PLO 3.2: Lead and collaborate in multidisciplinary teams by applying project management, economic, and decision-making strategies, while responsibly conducting research and guiding team planning and evaluation	Does not contribute to the team efforts Fails to provide leadership Does not take initiative	Contributes little to the team efforts Provides limited leadership Takes minimal initiative	Always contributes to the team efforts Provides strong leadership and guides the team effectively Consistently takes initiative	Reports Lab works
PI 5.3: Goal Setting, Task Planning, Decision making, and Meeting Objectives (Project Management) **PLO 2.6: Apply project management, economic, and decision-making techniques while conducting research and investigations into complex problems.**	Fails to establish clear goals; lacks direction Fails to plan tasks effectively; lacks organization Fails to take appropriate decisions in a timely manner Fails to meet objectives; does not contribute to team success	Establishes goals but they are unclear or not well-defined Plans tasks but with limited effectiveness; some disorganization Attempts to take appropriate decisions to some extents Meets some objectives but with significant gaps; limited contribution	Establishes clear, well-defined, and achievable goals that guide the team's efforts effectively Plans tasks comprehensively and effectively, ensuring a well-organized approach Take appropriate decisions in a timely manner Consistently meets or exceeds objectives, making significant contributions to team success	Assignments Projects Presentations Seminars Reports Lab works

Rubric for KLO8 (SO-3): Effective Communication

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO8	Communicate effectively on engineering activities with a range of audiences	**SO-3**	an ability to communicate effectively with a range of audiences.

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 3.1: Clarity of Message **PLO2.7: Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.**	Fails to convey the message clearly; message is confusing or unclear	Conveys the message with some clarity, but there are still areas of confusion	Conveys the message very clearly and concisely with no ambiguity	Presentations Seminars Reports Posters
PI 3.2: Organization of Content **PLO2.7: Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.**	Do not follow the predefined template Content is poorly organized and lacks logical flow	Followed the predefined template partially Content is somewhat organized but lacks clear structure	Perfectly followed the predefined template Content is exceptionally well-organized, with a coherent and logical progression of ideas	Presentations Seminars Reports Posters
PI 3.3: Demonstrate proper use of English	Numerous errors in grammar,	A few errors in grammar, punctuation, spelling	Minimal errors in grammar, punctuation, spelling	Presentations Seminars

PLO/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PLO2.7: Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.	punctuation, spelling Many sentences have an incorrect construction Does not appear to have been proofread	A few sentences have an inappropriate construction Proofreading appears to have been done inadequately	Varied and creative sentence structure Demonstrates thorough proofreading and revision	Reports Posters
PI 3.4: Use of Visual Aids **PLO2.7: Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.**	Visual aids are absent, confusing, or irrelevant	Visual aids are present but not effectively integrated into the presentation	Visual aids are highly effective and enhance the understanding of the message	Presentations Seminars Reports Posters
PI 3.5: Adaptation and Engagement with Audience **PLO2.7: Communicate engineering concepts, knowledge, and skills effectively to diverse audiences across theoretical and practical contexts.**	Fails to adapt the message to the audience Uses inappropriate language or tone Fails to engage the audience Lacks eye contact, enthusiasm, or interaction	Partially adapts the message to the audience Language or tone may be inappropriate in some areas Limited engagement with the audience Some eye contact and interaction, but inconsistent	Fully adapts the message to the audience Uses highly effective language and tone Engages the audience exceptionally well Strong eye contact, enthusiasm, and meaningful interaction	Presentations Seminars

Rubric for KLO9 (SO-7): New Knowledge

Code	Key Learning Outcomes (KLOs) by NCAAA	Code	Student Outcomes (SOs) by ABET
KLO9	Engage in life-long learning for acquiring and implementing knowledge, as needed, using suitable learning strategies	**SO-7**	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
PI 7.1: Identifying the Needs and Selecting Strategies for Continuous Learning **PLO3.3 Pursue lifelong learning through effective strategies to acquire and apply knowledge, while actively contributing to the advancement of the mechanical engineering discipline and society.**	Fails to identify areas where new knowledge is needed Fails to select appropriate learning strategies for continuous learning	Shows limited ability to identify areas where new knowledge is needed Shows limited ability to select appropriate learning strategies for continuous learning	Accurately identifies areas where new knowledge is needed and seeks appropriate resources Accurately selects and applies effective learning strategies for continuous learning	Exams Assignments Projects Presentations Reports
PI 7.2: Acquiring New Knowledge to Stay Updated with the Latest Advancements in the Field of Mechanical Engineering **PLO3.3 Pursue lifelong learning**	Fails to acquire new knowledge effectively	Shows limited ability to acquire new knowledge effectively	Effectively acquires new knowledge using appropriate methods	Exams Quizzes Assignments Projects Presentations Reports

PLOs/Criteria	Unsatisfactory (1)	Developing (3)	Satisfactory (5)	Assessment
through effective strategies to acquire and apply knowledge, while actively contributing to the advancement of the mechanical engineering discipline and society.				
PI 7.3: Applying New Knowledge (Adapting to New Technologies, and Using Effective Strategies to Integrate This Knowledge in Their Work) **PLO3.3 Pursue lifelong learning through effective strategies to acquire and apply knowledge, while actively contributing to the advancement of the mechanical engineering discipline and society.**	Fails to apply new knowledge in relevant contexts	Shows limited ability to apply new knowledge in relevant contexts	Accurately and effectively applies new knowledge in relevant contexts	Exams Quizzes Assignments Projects Presentations Seminars Reports

The students' achievement of a given CLO is then calculated as:

$$\boldsymbol{Achievement\ of\ CLO} = (\mathbf{5} * \boldsymbol{N5} + \mathbf{3} * \boldsymbol{N3} + \mathbf{1} * \boldsymbol{N1}) * \mathbf{5/3} * \boldsymbol{Total\ number\ of\ Students}$$

Where N5, N3 and N1 are the number of students who respectively shown satisfactory, developing, and unsatisfactory performances.

9. Assessment and Evaluation Methodology

The assessment of courses is done in each semester and is specified in course reports. The target benchmark for each CLO is set by the subject committee through the KPI measurements assigned to each KLOs. The target benchmark for each PLO is set by the quality committee by taking the average of the CLO attainment. The methodology is explained as following

- Framing the rubrics (unsatisfactory, developing, and satisfactory) for each outcome to determine the acceptable level of achievement.
- Identify measurable performance targets associated with the assessment strategy and evaluation using rubrics to determine whether the student outcomes have been achieved.
- Analyzing the satisfaction each KPI by an internal benchmarking obtained by an averaging the level achievement in 5-point scale.
- Identifying the strengths and recommendations for improvement by rubric analysis of a course by analyzing the level of attainment.
- Forwarding the attainment of each course learning outcome for the evaluation of student outcomes.
- Fairly calculate the attainment of student outcomes from the selected courses

The target benchmark for the student outcome is set by the program to indicate realistic amount of improvement needed to achieve the required performance. Initially, the performance target value is set to 70% of the total value assessments, which is 3.5 on a five-point scale. After the assessment, if the results are more than the performance target, then the target value is raised by 5-10% for the next assessment. If we do not meet the performance target, then the target value is kept the same for the next assessment.

10. Program Strengths, Areas, and Priorities of Improvements

Program strengths are evaluated through CLO analysis at course level, 17 program KPIs specified by NCAAA at program level, Surveys, feedbacks, and Student outcome assessments. The actions and recommendations from these direct and indirect measurements are well documented and are presented in Annual Program Report end of every semester. Program ensures that the recommendations are fulfilled at course level and program level in the succeeding academic year to improve the program quality and close the quality loop.