KINGDOM OF CAMBODIA
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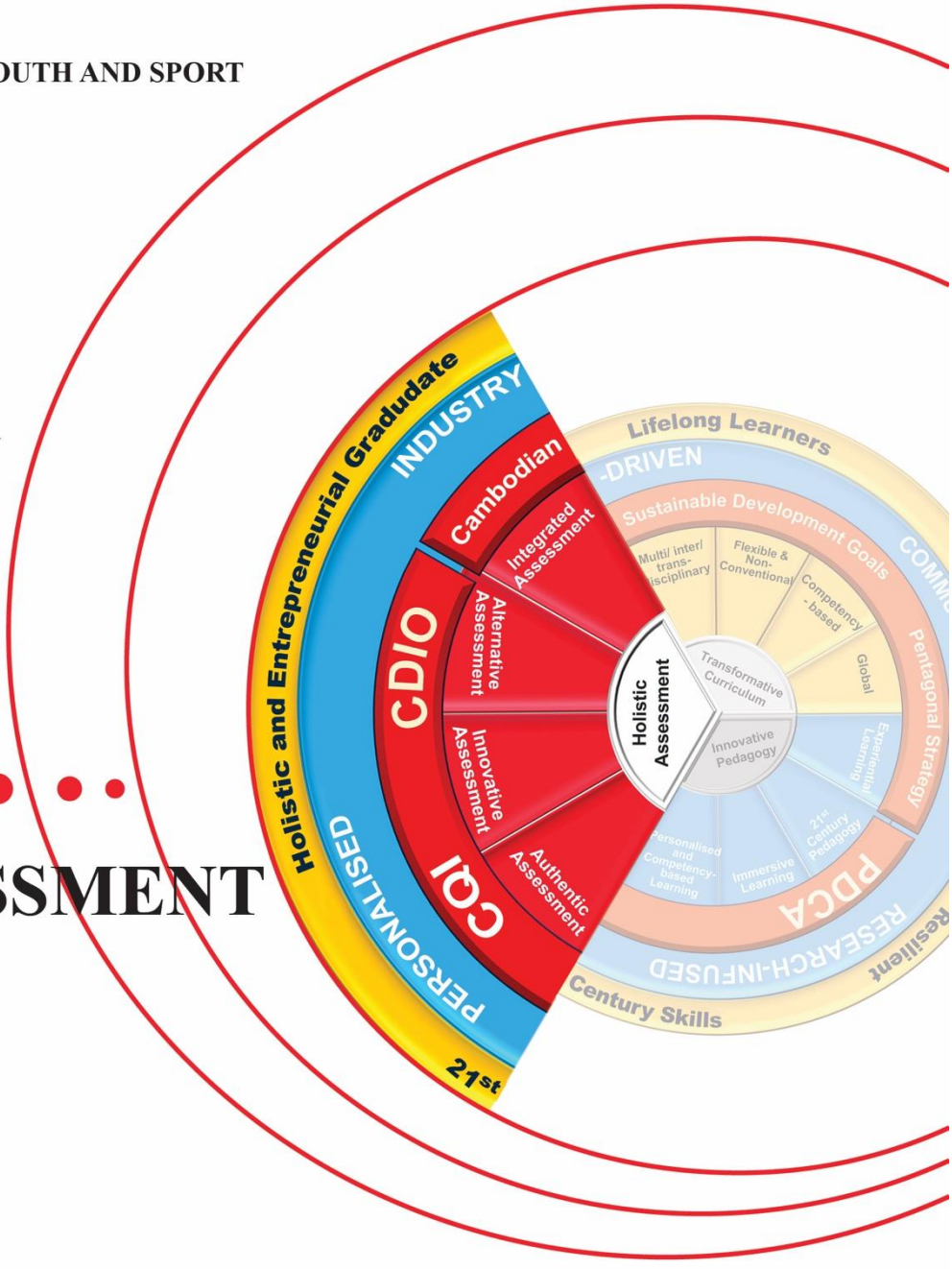
GUIDELINE ON

HOLISTIC ASSESSMENT



FUTUREFIT EDUCATIONAL FRAMEWORK FOR OUTCOME-BASED EDUCATION IN CAMBODIAN HIGHER EDUCATION

DIRECTORATE GENERAL OF HIGHER EDUCATION

First Printing, 2026

Published by:
Directorate General of Higher Education
Ministry of Education, Youth and Sport
No. 169, Preah Norodom Boulevard,
Phnom Penh, Cambodia
www.moeys.gov.kh

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LIST OF ABBREVIATIONS

Abbreviations	Full Words
AI	Artificial Intelligence
AltA	Alternative Assessment
AUN-QA	ASEAN University Network-Quality
AA	Authentic Assessment
CQF	Cambodian Qualification Framework
CA	Constructive Alignment
CAP	Course Assessment Plan
CLO	Course Learning Outcome
CQI	Continuous Quality Improvement
DCS	Detail Course Syllabus
FEF	FutureFit Educational Framework
GHA	Guideline on Holistic Assessment
GIP	Guideline on Innovative Pedagogy
GTCD	Guide on Transformative Curriculum Design
HEI	Higher Education Institution
HA	Holistic Assessment
IA	Innovative Assessment
KSA	Knowledge, Skills and Attitudes
IntA	Integrated Assessment
LD	Learning Domain
LO	Learning Outcome
MD	Main Domain
OBE	Outcome-Based Education
PDCA	Plan, Do, Check, Act
PEO	Programme Educational Objective
PCB	Print Circuit Board
PLO	Programme Learning Outcome
SLT	Student Learning Time
ToS	Table of Test Specification

GLOSSARY

Term	Definition
Alternative Assessment	An approach that accommodates various learning styles and preferences by offering a variety of opportunities to demonstrate knowledge and abilities outside of typical tests and exams.
Assessment	Ongoing process to improve students' learning by measuring what they have learned (learning outcomes) through both formal and informal forms of assessment.
Assessment as Learning	It is a form of formative assessment. It involves students actively conducting self-assessment, self-monitoring and self-reflection to monitor their learning progress or make adjustments for deeper understanding.
Assessment for Learning	A formative and diagnostic assessment, which enables instructors and students to work together in an interactive process through feedback and coaching.
Assessment of Learning	Generally, a traditional assessment, which is in the form of summative assessment and norm-referenced assessment. The purpose of assessment of learning is to provide evidence of how well students' learning is and used for employment purposes, scholarships and further study.
Assessment technique	Assessment techniques refer to evaluation methods and instruments utilized by instructors to assess students' learning outcomes.
Authentic Assessment	An approach that requires students to perform tasks and activities related to real-life situations by applying their knowledge and skills to actual situations to ensure relevance of the contents learned and to better prepare them for the workplace.
Constructive Alignment	It is an approach to curriculum design and delivery in which learning outcomes, teaching and learning activities and assessment are integrated to create the conditions for high-level learning.
Continuous Quality Improvement	Continuous Quality Improvement (CQI) is an essential mechanism within academic programmes to enhance the quality of education.
Course Assessment Plan	A comprehensive document outlining the assessment strategies within a course, ensuring alignment with learning outcomes and facilitating meaningful student learning outcomes. The plan may include key components such as topics, teaching learning activities, defined learning outcomes, assessment strategies, and the weighting of assessment.
Course Learning Outcome	Statements that describe the specific and general knowledge, skills, attitude and competencies that the

	students should demonstrate upon the completion of the course.
Digital tools for assessment	Digital tools, including apps and media used to check understanding and concepts such as online quizzes, in-class questions, polls, survey or discussion for formative assessment. It is also available for summative assessment, including online tests, exams, or e-portfolios to measure students' knowledge, skills and competencies. Some common digital tools are Web 2.0 tools such as Padlet, Kahoot, and other digital tools Google Doc, Google forms, Microsoft Teams, Moodle, etc.
Direct assessment	Refers to any methods of collecting data on a student's performance that requires students to demonstrate knowledge, skill, or behaviour.
Criterion-referenced assessment	Type of assessment designed to measure and reflect actual performance and progress of each student, allowing explicit incorporation of higher-order cognitive skills so that assessment can better reflect these abilities.
Feedback of student assessment	Feedback provided by instructors to students after the assessment, test or exam to help improve student's performance. It is an explanation of what they are doing correctly and incorrectly, with the focus of the feedback on what the students is doing right.
Formative assessment	It is an assessment for learning for continuous improvement for both teaching and learning activities, and students' learning. It is conducted during the class or learning process.
Holistic Assessment	It provides a comprehensive approach to evaluation of students' knowledge, skills and attitudes (KSA) towards each CLO.
Innovative Assessment	This approach focuses on knowledge, skills and competency assessment, in which students are required to be actively engaged in the real world or a work environment. Most often technological tools are used in the assessment.
Indirect assessment	Refers to any methods of collecting data on a student's performance that requires reflection on student learning, skills, or behaviours, rather than a demonstration of them.
Integrated Assessment	Integrated assessment is a thorough process that blends several techniques and instruments to evaluate learning and give a complex picture of students' development and performance.
Norm-referenced assessment	Type of evaluation to compare individuals within the group but the group performance can influence individual grades which can be unfair.
Program Learning Outcome	Statements that describe the specific and general knowledge, skills, attitude and competencies that the

	students should demonstrate upon completion of the study programme.
Summative assessment	Type of evaluation that measures students' learning outcomes at the end of the course or semester.
Table of Test Specification	A tool used by instructors to ensure that classroom tests are well-aligned with the curriculum, teaching objectives, and the instruction delivered.

1. Introduction

The FutureFit Educational Framework (FEF) for Outcome-Based Education (OBE) in Cambodian Higher Education is the main source of reference and the guidance framework for academic programme development (See Figure 1) to produce graduates with knowledge, skills and attributes to be ready for the future challenges in the changing world. The framework provides guidance to instructors and university management on the whole process of curriculum design, teaching and learning delivery, and assessing student's learning aligned with the OBE principles, which mainly focus on (i) what is learnt rather than what is taught in class, (ii) appropriate intended learning outcomes, and (iii) constructive alignment of learning outcomes in terms of contents, teaching and learning methods, and assessment methods. To achieve this framework, it is thus necessary to produce three supporting and complementary guidelines, which are Transformative Curriculum Design, Innovative Pedagogy, and Holistic Assessment.

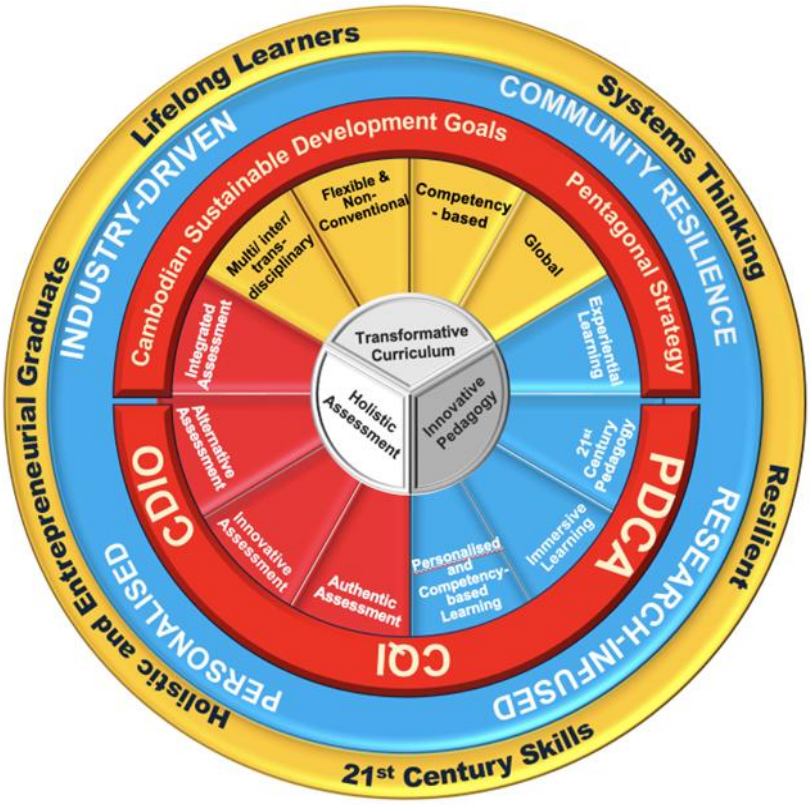

Figure 1: FutureFit Educational Framework (FEF) for Outcome-Based Education in Cambodian Higher Education

This guideline covers only on holistic assessment to meet the aspiration of FEF and it is supportive of and consistent with the guidelines on Transformative Curriculum Design (GTCD) and Innovative Pedagogy (GIP). It is also a guidance document that assists higher education institutions (HEIs) in designing strategies, techniques, and tools for assessment of academic programme development and delivery. Based on this guideline, HEIs can develop their internal documents, in the form of playbooks on holistic assessment for their respective HEI that is aligned to their university's vision and mission, and to the needs and requirements of individual HEI to improve learners' learning outcomes and to make sure appropriate assessment methods and mechanisms are in place for programme quality improvement and the achievement of learning outcomes.

This guideline focuses on the strategies, procedures and tools used in the assessment for programme quality improvement and students' learning outcomes. It begins with the concept

of holistic assessment and the types of assessments, with examples on how to conduct assessment for interdisciplinary programmes. The types of assessment techniques, procedures for assessment of student progress, the achievement of expected learning outcomes of the programme, and principles of assessment to ensure validity, reliability and fairness in assessment are then incorporated. Finally, assessment tools for marking and grading, management of assessment, and continuous quality improvement (CQI) for academic programmes by analysing the attainment of programme learning outcomes (PLOs) and course learning outcomes (CLOs) are discussed.

The Guideline for Holistic Assessment (GHA) is a document developed to assist Cambodian Higher Education Institutions (HEIs) to meet the national standards in IQA guideline and the standards of Student Assessment (Criterion 4) of the ASEAN University Network – Quality Assurance (AUN-QA) Assessment at Programme Level Version 4.0 (2020), in which there are seven requirements ((i) Constructive alignment of a variety of assessment methods, (ii) Presence of assessment and assessment-appeal policies, (iii) Availability of assessment standards and procedures for students performance progress and degree completion, (iv) Availability of rubrics, making schemes, timelines and regulations included in assessment methods;, (v) Assessment methods to measure achievement of PLOs and CLOs, (vi) Timely provision of feedback on student assessment, and (vii) Implementation of CQI for further improvement). The guideline provides the pertinent elements in conducting holistic assessment. However, HEIs are not to merely copy the guidelines and the examples given in the document; each needs to develop their own to meet the specific needs of the programme and the students.

What is Assessment?

Assessment is an ongoing process to improve students' learning by measuring what they have learned through both formal and informal forms of assessment, including group presentation, group projects, student portfolios, and journaling. Information collected and feedback are shared with students, so that they know how to improve their achievements. Three complementary functions of assessment are useful in promoting student success and informing instructional practices. There three main functions for assessment are as follows:

i. Assessment of Learning: It is generally a traditional assessment, which is in the form of summative assessment and norm-referenced assessment. Usually, the output of the assessment is scores, determined through grade-based assessment including placement tests, final exams and final projects to make judgements on student achievement or performance. The purpose of assessment of learning is to provide evidence of how well students' learning is and used for employment purposes, scholarships and further study.

ii. Assessment for Learning: It is in contrast to the assessment of learning. It is a formative and diagnostic assessment. Assessment of learning enables instructors and students to work together in an interactive process through feedback and coaching. Feedback on student progress during teaching and learning is used to inform and improve teaching by instructors and learning by students, for example, in providing oral or written feedback to students after their presentation or peer assessment.

iii. Assessment as Learning: It is an ongoing self-assessment in a formative form. It happens when students conduct self-reflection to monitor their learning progress or make adjustments for deeper understanding. Some examples of assessment as learning are self-assessment, peer assessment, writing reflective entries either in journals, forums (online), or completing online quizzes. This enables students to receive feedback to inform their future learning goals.

2. Concept of Holistic Assessment

Modernised curriculum, that is designed to produce graduates who are ready for the future challenges as stated in the FEF, responds to the enablers and the drivers according to the

current needs, and embeds all the domains as outlined in the Cambodian Qualifications Framework (CQF). As shown in the outer layer of the FEF, the Cambodian modernised curriculum intends to produce students whose attributes include possessing the 21st century skills, systems thinking as well as being holistic and entrepreneurial graduates. These can only be achieved if the curriculum is designed to embed all the relevant learning outcomes, delivered innovatively in the teaching and learning process, and all assessments are constructively aligned to the learning outcomes and the teaching and learning activities. As outlined in GTCD, an academic programme must fulfil 10 learning domains. Hence, this requires a more holistic approach in conducting assessment in terms of competency, feedback, and marking.

Holistic assessment provides a comprehensive approach to evaluation of students' knowledge, skills and attitudes (KSA) towards each CLO. In holistic assessment, a variety of assessment approaches is used to assess students' KSA. In this guideline, holistic assessment focuses on the following four concepts, namely (i) Authentic Assessment, (ii) Innovative Assessment, (iii) Alternative Assessment, and (iv) Integrated Assessment. These assessments relate to assessment of courses. Different CLOs will require different forms of assessment. Each academic programme shall require all instructors to use a variety of holistic assessment approaches to assess students' learning outcomes.

This section outlines holistic assessments that instructors might consider adopting to determine where and how they want to assess their students to know what they are able to do at a certain point. The section provides the definition, purpose, and characteristics of each assessment with examples. Through this guideline, instructors can have a clear guide on what method of assessment shall be used, for what purpose, and how to use the assessment to assess students' learning outcomes.

2.1. Authentic Assessment

As stated in the FEF (2024), 'authentic assessment' is a type of holistic assessment that requires students to apply their knowledge to actual situations in order to make sure that what they have learned is useful outside of the classroom. It is an ongoing and formative assessment. This assessment requires students to perform tasks and activities in real-life situations by applying their knowledge and skills to actual situations to ensure relevance of the contents learned and to better prepare them for the workplace. Instructors can create engaging and meaningful learning experiences that prepare students for real-world challenges and opportunities.

For this assessment, instructors can use performance-based or competency-based assessments to assess higher order thinking skills of students. Students can be assessed on how they apply problem-solving skills to complete complex case studies or tasks to integrate knowledge and create a deeper understanding of the concept under study. Authentic assessment focuses more on contextualised tasks, which enable students to apply or demonstrate their competency in a more 'authentic' setting in terms of performance of the skills, or demonstrating use of a practical knowledge, and simulations and role plays.

Characteristics of authentic assessment emphasises the following:

i. Students' performance to demonstrate knowledge, skills or competencies in appropriate situations.
ii. Clear criteria for performance and well-defined purposes.
iii. Criterion-referenced rather than norm-referenced. In criterion-referenced assessment, a student's performance is evaluated against a fixed set of predetermined criteria to gauge whether the student has achieved specific skills or knowledge. In contrast, norm-referenced assessment compares a student's performance to that of other students in the group.
iv. Role of students is to be more active and involved in assessment activities.

Examples

In the Entrepreneurship class, students need to create network with some local small medium enterprise (SME) partners that the instructor has identified. They analyse the needs of the SMEs, develop a business plan and present it to a panel of SME partners for feedback.

For a history course, students are required to participate in a simulation of a historical event, such as a mock Constitutional Convention, where they debate and draft amendments based on their assigned roles as historical figures.

2.2. Innovative Assessment

Innovative assessment is making use of cutting-edge tools and techniques, including artificial intelligence (AI)-based instruments and platforms, to assess student learning in a way that is more thorough, interesting, and customised to meet specific learning objectives (FEF, 2024). It leverages technology to create engaging, efficient, and effective ways to measure student learning and progress. By incorporating technology into assessment practices, instructors can create more dynamic, engaging, and effective ways to evaluate student learning, preparing students for the demands of the digital age. This assessment is used to assess students' learning progress to improve quality and to determine if it meets specific learning outcomes. There are many forms of innovative assessments, including case-study based assessment, practical assessment, video interviewing, adaptive assessment quizzes or other assessment methods to actively engage students in learning.

The purpose of innovative assessment is to enable the learners to transfer knowledge, skills, competencies and dispositions between learning and assessment. Instructors may use this assessment to measure students' learning to any area, including real-world scenario, work environment or a higher level of education. Instructors may integrate technology as a tool to enhance students' learning and understanding. Similar to authentic assessment, this approach also focuses on knowledge, skills and competency assessment, in which students are required to be actively engaged in the real world or a work environment but most often technological tools are used in the assessment, making it more innovative.

Characteristics of innovative assessment are the following:

i. Knowledge, skills and competency assessment
ii. Technology-integrated assessment
iii. Students' roles are more active and engaged in the real world.

Examples

In a practical lesson, instructors assign tasks to students to conduct experiments in the lab. Instructors may not be able to be in the lab to see the real practice to check and evaluate students' work. In this case, instructors can integrate innovation to assess students at anytime and anywhere. Students need to upload the result file created by software/technology after the completion of experiments.

Students use a virtual lab to conduct experiments with chemicals that might be too dangerous or expensive to use in a physical classroom.

Students create a digital portfolio of their essays, multimedia projects, and reflections on their learning journey.

2.3. Alternative Assessment

Alternative assessment is an approach that caters to various learning styles and preferences by providing a range of opportunities for students to demonstrate knowledge and abilities beyond conventional tests and exams (FEF, 2024). It is especially crucial in assessing the extensive range of learning domains integrated in the curriculum that cannot be adequately gauged

through traditional testing methods. The primary purpose of alternative assessment is to measure students' ability to execute complex tasks in real world scenarios, as outlined in the learning outcomes. Hence, alternative assessment is also authentic because it engages students in actual practices or real-world situations. It focuses on the student's ability to apply integrated skills and knowledge in various contexts, often emphasizing creativity, critical thinking, and practical application to solve problems rather than memorising facts and correcting answers. Through alternative assessment, instructors may know or determine what students can do with what they have learnt and what they cannot do. Instructors can use collaborative groups, multimedia presentation, concept maps, project-based, summary and reflections for the alternative assessment. In project-based assessment, students complete complex tasks that integrate knowledge from various subjects. In self-assessment and peer-review, individual students can reflect on their own performance and provide feedback to their peers.

Common characteristics of alternative assessments are as follows:

i. More focused on personal and individual competency, more student-centered approach, student's reflection, peer review, skills and attitude assessment.
ii. Alternatives in terms of formats of assessment, forms of assessment and uses of assessment.
iii. Performance and authenticity, and higher-level thinking and problem-solving skills assessment (identify complex ideas, analyse and propose solution, summarise relevant literature, identify and analyse the main points, apply theory to practice or real-world contexts, present and justify an idea, solution or plan for proposal)
iv. Many forms of alternative assessments (collaborative group, multimedia presentations, concept maps, annotated bibliography, summary, critical reflection, proposal)
v. Evaluation criteria and standards are known to the students in advance.
vi. Receiving feedback in terms of relevant and defensible criteria.
vii. Providing information about students' strengths and weaknesses.

Examples

In an engineering course, students design and build a prototype of an innovative product and presenting their project to a panel of industry experts.

In assessing affective domain, students are required to participate in a debate on the merits and drawbacks of a particular public policy, using research to support their positions.

Students conduct fieldwork by visiting a local wetland, collecting data on plant and animal species, and writing a report on their findings.

2.4. Integrated Assessments

As defined in the FEF, integrated assessment is a thorough process that blends several techniques and instruments to evaluate learning and give a complete picture of students' development and performance. It is an assessment approach for interdisciplinary processes by combining, interpreting and communicating knowledge from diverse scientific disciplines. Hence, it provides a cohesive assessment framework that aligns with curriculum goals and instructional strategies, offering a holistic view of student performance and progress.

This ongoing assessment allows instructors to create a learning platform and engage students with real contexts in life; and students receive information and feedback for better improvement of what they have learned. It also enables students to demonstrate higher order learning behaviours by applying knowledge and skills through analysing, synthesising and critical thinking. Instructors can categorise the integrated assessments into direct and indirect assessments. Direct assessments include quizzes, lab reports, presentations, final exams, design projects, and research work, for knowledge and skills assessment. In contrast, indirect

assessments such as surveys, interviews, and reports on graduation, placement, and retention for information provision to the learning quality for the required changes in the course contents. Instructors may use this integrated assessment by using well-defined scoring guides such as rubrics to assess students' achievement in terms of learning outcomes.

Characteristics of integrated assessment emphasises the following:

i. Multi assessment techniques and disciplines integration assessment.
ii. Clear defined purpose and scope of concepts and skills integration
iii. Higher order thinking skills assessment
iv. Students' roles are active and engaged in different subjects and skills in real world problem

Examples

Students are required to research urban planning and the implications of sustainable living and to report based on several relevant disciplinary perspectives. This task assists students in finding, translating and paraphrasing multiple disciplinary perspectives. Through this task, students apply skills across disciplinary contexts.

Conducting a capstone project which is a comprehensive project that requires students to synthesise and apply learning from an entire programme. Students are asked to create a comprehensive business plan for a new start up, including market research, financial projections, marketing strategies, and operational plans.

In summary, all four methods of holistic assessment are authentic in nature. This is because each requires students to be engaged in real context or scenarios. However, the nature of each assessment methods in terms of the tasks, tools, or discipline, allow for classifications into four distinct but overlapping methods of holistic assessment.

3. Types of Assessment

The process of assessment in education is broad and complex, with the goal of determining, measuring, and recording students' academic preparedness, learning progress, skill development, or educational requirements. There are several types of assessment and each has its own unique purpose for assessing students' learning. This section highlights and discusses differences of some common types of assessment mostly used by instructors to measure students' knowledge, skills and competencies. They are (i) Formative and summative assessment, (ii) Direct and indirect assessment and (iii) Norm-referenced and criterion-referenced assessment.

3.1. Formative and Summative Assessments

Formative assessment is a way of giving feedback and information to students on the progress of their learning while the learning process is ongoing. Formative assessment focuses on the regularity and integration of assessment into the learning process and giving feedback to both teachers and students for better improvement in teaching and learning. It is an assessment of learning for continuous improvement for both teaching and learning activities, and students' learning. It helps to measure how well the students are learning, and also how well the teaching method is conducted. For example, instructors can use observation or surveys to evaluate a new activity used in class, and then decide if they want to keep the activity or modify teaching and learning activity for better improvement.

The main goal of formative assessment is to find out what needs to be improved. This assessment is usually not graded and serves as a tool to monitor students' learning progress and teaching effectiveness (using suitable techniques and activities). Types of formative assessment includes quizzes, in-class activities, homework assignment, class discussion, reflection journals, question and answer sessions, peer assessment etc.

Summative assessment is a type of evaluation that measures the learning outcomes in the education process, offering a comprehensive evaluation of students. Summative assessment is conducted at the end of a course or semester to evaluate overall student learning and achievement. It provides feedback and information that summarises the effectiveness of the instructional process. For summative assessment, instructors can use rubrics based on a set of standards or expectations to evaluate the students' work. This assessment usually happens at the end of the course and for grading purposes. Rubrics can be provided to students before they start working on a specific project, so that they can understand what is expected of them (exactly what they have to do) for each of the criteria.

The purpose of summative assessment is to measure how well students have learned, competences, or learning objectives. It occurs in the forms of final term, final exams, standardized tests, projects, portfolios, and presentations. Summative assessments are scored or graded and are frequently used for certification and accountability. Table 1 illustrates the comparison between formative and summative assessment.

Table 1: Comparison between Formative Assessment and Summative Assessment

Aspects	**Formative Assessment**	**Summative Assessment**
Definition	Give feedback and information to instructors and students in order to modify teaching and learning activities.	Determine students' achievement at the end of course or program.
Purpose	Monitor students' performance for better improvement.	Measure students' competences and achievement, and assign grades.
Reliability	Delivers timely feedback but may not be as consistent as summative assessments.	Considered more consistent as it assesses overall performance at the end of a historical learning.
Context	Use during a course to inform teaching and improve students' performance.	Use at the end of a course or semester to measure students' learning achievement.
Limitations	May not always accurately reflect final achievement.	Does not provide immediate feedback for improvement.
Examples	Quizzes, Class discussions, homework assignment, question and answer sessions, peer assessment.	Final Exams, final projects, final term, standardised tests, portfolio.

3.2. Direct and Indirect Assessments

Direct Assessment refers to any method of collecting data on a student's performance that requires students to demonstrate knowledge, skill, or behaviour. It is direct examination or assessment of students' knowledge, skills or behaviours. There are various forms of direct assessment including final exams, quizzes, standard tests, term papers, projects, reports, presentations, course portfolios, etc., where CLOs can be measured directly.

Indirect Assessment refers to any method of collecting data on a student's performance that requires reflection on student learning, skills, or behaviours, rather than a demonstration of them. These are the methods for assessing secondary information on student learning that do not rely on actual samples of student work. One way to indirectly assess learning outcomes is to ask students to rate their own abilities and knowledge related to the learning outcomes. Another source of indirect evidence is student self-reflection or self-assessment, which can be done through papers or assignments. The key is to make sure that the questions in the student survey or the prompts for the paper are aligned with the learning outcomes. The indirect assessments include course evaluation survey and stakeholders survey, including alumni and interviews with employers learning outcomes exit survey, etc.

In order to ensure a consistent and fair assessment of students' work, rubrics or scoring guides are used in both direct and indirect evaluations to specify expectations and criteria for student work. Rubrics are especially helpful since they give apprentices thorough feedback that might improve learning and performance in the future. In essence, direct assessment measures the actual learning outcomes, while indirect assessment measures the perceived value of the learning experience. Rubrics serve as a bridge to ensure clarity and fairness in the assessment process. Table 2 shows the comparison between direct and indirect assessment.

Table 2: Comparison between Direct Assessment and Indirect Assessment

Aspects	Direct Assessment	Indirect Assessment
Definition	Involves directly perceiving or evaluating student performance or behaviour.	Relies on self-reported or indirect measures of student learning or perception.
Purpose	Assess specific skills or knowledge.	Gather information about students' experiences, attitudes, or perceptions.
Reliability	Generally considered more reliable.	May be influenced by bias or subjectivity.
Context	Typically used in academic or skill-based settings.	Can be used in various contexts (academic, organizational, etc.).
Limitations	May not capture all aspects of learning.	Responses may not always accurately reflect true abilities or experiences.
Examples	Quizzes, peer assessments, final exams, standard tests, term papers, projects, reports, presentations, course portfolios	Survey on self-report on learning outcomes, course evaluation survey and stakeholders survey (alumni and interviews with employers), learning outcomes exit survey.

3.3. Norm-referenced and Criterion-referenced Assessments

The purpose of norm-referenced assessment is to produce an order of students' ranking relative to a group. This assessment is able to compare individuals within the group but the group

performance can influence individual grades which can be unfair. It is used in standardised tests, percentile rankings etc. such as the Record Graduate Examination (GRE) to compare applicants' abilities. It is also referred to as 'grading on the curve' where a certain percentage of students will get As, Bs and Cs, etc, based on their relative performance.

Norm-referenced assessments are a valuable tool in university teaching for comparing student performance and making decisions in competitive contexts, to award scholarships, grants etc. However, their use should be balanced with other types of assessments to provide a comprehensive evaluation of student learning and to support all students in achieving their educational goals.

Criterion-referenced assessment is designed to measure and reflect actual performance and progress of each student, allowing explicit incorporation of higher-order cognitive skills so that assessment can better reflect these abilities. However, there is no control on grade distribution which can lead to grade inflation and it is less able to compare individual performance against the cohort. Instructors can use rubrics, proficiency scales, and mastery assessments for criterion-referenced assessment. Table 3 shows comparison between norm-referenced and criterion-referenced assessment.

Table 3: Comparison between Norm-referenced Assessment and Criterion-referenced Assessment

Aspects	Norm-referenced Assessment	Criterion-referenced Assessment
Definition	Compares individual student performance to a norm or average of a group.	Determines whether students have achieved specific learning objectives or criteria.
Purpose	Rank students relative to each other.	Measure a student's proficiency with particular learning objectives or standards.
Reliability	May be less reliable as it depends on the performance of the group being compared.	Generally, more reliable as it focuses on specific learning outcomes.
Context	Often used for high-stakes assessments or to compare students nationally or internationally.	Commonly used for classroom assessments to measure mastery of specific skills or knowledge.
Limitations	May not provide a clear picture of individual student mastery or growth.	May not account for individual differences or growth over time.
Examples	Standardised tests, percentile rankings.	Rubrics, proficiency scales, mastery assessments.

4. Principles of Assessment

Assessment is an important tool to measure the efforts of students during the learning process. Within this tool, instructors can observe students' abilities. HEIs shall have assessment and assessment-appeal policies that enable students to request for review of assessment result or grade. These policies shall communicate to students and apply consistently in HEIs. Instructors shall explain course specification to students when class starts and can provide feedback to the students during and after task or assignment assessment in order to improve their capabilities. To guarantee the effectiveness of the assessment, the process of assessment

must follow the principles of assessment, which are validity, reliability, fairness, equity, variety, and constructive alignment (Figure 2). Each academic programme shall require instructors to follow these principles of assessment as the process of assessment stated in the guideline on Holistic assessment. Besides these 6 principles, there are many principles of assessment that instructors can adopt during the assessment process. However, instructors must include at least these 6 principles in the assessment process.
In this section, principles of assessment are discussed in detail, with examples.

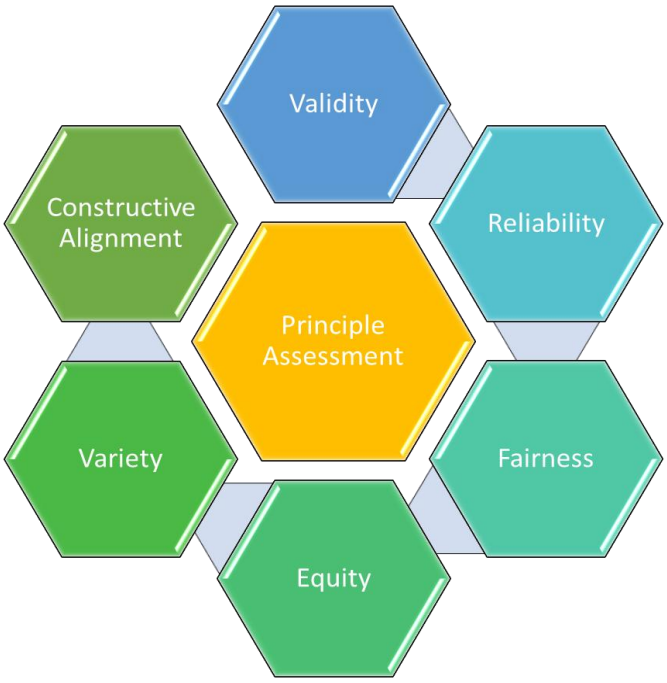

Figure 2: Components of Principles of Assessment

4.1. Validity

Validity is an important principle when designing an assessment. Validity helps instructors design correct test questions and other assessment tasks to measure learning outcomes. There are a few types of validity. However, this section will focus on two specific types of validity crucial for test development to ensure effective assessment: content validity and construct validity.

4.1.1. Content Validity

Content validity refers to the degree to which the content of an assessment is relevant and representative of the construct it is intended to measure. In other words, it refers to the extent to which the content of an assessment, especially tests and exams, represents the domain of knowledge or skills it is intended to measure. In establishing content validity in a class assessment, the instructor needs to ensure that the assessment accurately reflects the material covered in the class and that it aligns with the CLOs. Content validity can be established using methods such as (i) alignment to CLO (ii) Course Assessment Plan (see Section 4.7.1) and (iii) Table of Test Specifications or Test Blueprint (more applicable for test and exams) (see Section 4.7.2). In simple terms, it is about ensuring fair and comprehensive coverage of the course contents through the various assessment tasks planned. Content validity can be ascertained by an expert panel through a committee to evaluate test/exam coverage or overall coverage for all assessments in the course.

For a better understanding of the content validity, a course in engineering 'Power Electronics' is provided as an example. This course contains three CLOs, but in this example, we are focusing only on CLO2, which aims to equip the students with the ability to design a suitable and economical power electronics converter for the requirements specified. To measure the

ability of the student for this CLO and in ensuring that the content is valid, an assessment needs to be constructed to test the student's performance in designing the converter based on (i) theories, (ii) selection of components, (iii) design of the PCB using software, and (iv) testing. Thus, the assessment cannot be conducted as the traditional lab, which plugs into the board with the given components. The lecturer must provide a case study with the exact specification and assess it based on the criteria above.

4.1.2. Construct Validity

Construct validity refers to the degree to which a test or measurement accurately assesses the underlying theoretical construct it intends to measure. In other words, construct validity is used to guarantee that the assessment actually measures what it is supposed to measure. It involves evaluating the relationships between the test and other assessments to determine if they are aligned to the CLO.

For example, the CLO1 for Power Electronics course aims to provide the student the basic knowledge in Power Electronics. The assessments are provided as Class Test 1 and 2, Midterm, and Final that covers three topics in the course. From these tests and exams, we make sure that the students are assessed on CLO1 that aligns to the purpose of the learning outcomes.

4.2. Reliability

Establishing reliability in assessments is crucial to ensure that the results are consistent, stable, and accurate over time. There are different types of reliability, that each type addresses a different aspect of assessment consistency. In the normal conduct in establishing reliability, the following are some practices commonly used to establish reliability which instructors can practise:

i. Include a sufficient number of questions to adequately assess competence.
ii. Ensure the test duration is appropriate, which can be determined by soliciting feedback.
iii. Provide a consistent environment for all test-takers.
iv. Give clear instructions to avoid confusion.
v. Use a user-friendly exam format; avoid excessive variety in question types such as multiple-choice, matching, essay, etc.
vi. Arrange seating to ensure test-takers' comfort.
vii. Maintain a conducive atmosphere in the examination room.
viii. Acquaint participants with the assessment user interface, especially for online tests.
ix. Provide thorough training for human raters if the assessment involves multiple examiners.

To further enhance reliability, statistical measures can be utilised to identify high-quality questions for the question bank. Two tests that can be conducted are test-retest reliability and internal consistency test.

4.2.1. Test-Retest Reliability

This involves administering the same test to the same group of people at two different points of time. The aim is to check for consistency in the results, which means the scores of Test 1 and Test 2 can then be correlated in order to evaluate the test for stability over time. Establishing reliability of tests through the test-retest method is especially useful in establishing consistent and dependable results. Sets of tests can be tested over the semesters to increase their reliability, allowing the instructors to keep the good questions or sets of tests.

As an example, an instructor does a test on Power Electronics for a group of 10 students. The first test results are given in Table 4 (Test #1 column). A month later, the instructor administers an equivalent test with the same difficulty level but consisting of different questions. The

second test results are as shown in the second column. In the concept of test-retest reliability, the results of the two tests must exhibit high correlation which indicates high reliability.

Table 4: Students' Scores in Repeated Tests

Student ID	Student Name	Test #1	Test #2
IDxxxA	Student A	82	79
IDxxxB	Student B	75	73
IDxxxC	Student C	88	85
IDxxxD	Student D	90	87
IDxxxE	Student E	68	70
IDxxxF	Student F	77	74
IDxxxG	Student G	85	82
IDxxxH	Student H	80	78
IDxxxI	Student I	92	90
IDxxxJ	Student J	70	72

The instructor needs to calculate the correlation coefficient based on the scores provided. He/she can calculate the Pearson correlation coefficient for these scores, which is commonly used to measure the degree of linear correlation between two sets of data. The Pearson correlation coefficient for the first and second test scores is approximately 0.981. This indicates a very high degree of linear correlation, suggesting that the test exhibits high test-retest reliability. This result would confirm the stability and consistency of the assessment over time.

4.2.2. Internal Consistency

Internal consistency assesses the correlation between multiple items in a test that are intended to measure the same construct. It can be calculated without repeating the test. Most often a statistical measure is used, such as Cronbach's alpha or split half reliability test.

To evaluate the internal consistency of a test, begin by selecting a representative group of test-takers who will take the test under standardised conditions. After administering the test, the instructor scores each participant's responses according to established criteria. Assess internal consistency using two key methods: Cronbach's alpha and split-half reliability.

(i) Cronbach's alpha is calculated using statistical software and reflects the correlation among test items, with values closer to 1 indicating higher consistency. Typically, values above 0.7 are deemed acceptable.

(ii) Split-half reliability involves dividing the test into two halves (e.g., odd vs. even items) and calculating the correlation between the scores of these halves, with higher correlations suggesting better consistency. Similarly, values above 0.7 are deemed acceptable. If it is lesser than 0.7, consider revising the test items to improve consistency. If revisions are made, repeat the process to ensure the internal consistency of the revised test has improved, thus enhancing the test's reliability and effectiveness.

4.3. Fairness

Fairness in testing is a fundamental principle that ensures assessments provide equal opportunities and unbiased results for all test-takers, irrespective of their background or characteristics. It encompasses the accuracy of what the test is intended to measure (validity) and the consistency of the results (reliability) across different groups. Fairness also involves eliminating biases that could influence test outcomes due to a person's race, gender, ethnicity, socioeconomic status, or other demographic factors. This principle extends to the cultural

relevance of the test content and the avoidance of language or references that could favour certain groups over others.

To ensure fairness, tests must undergo rigorous evaluations and continuous improvements. This involves standardised test administration to maintain uniform conditions across all sessions and transparent communication of scoring criteria to all participants. The development and validation process should include a diverse array of stakeholders, including experts from various backgrounds, to integrate multiple perspectives. Additionally, regular statistical analyses, item reviews, and feedback from diverse stakeholders help identify and address any fairness-related issues.

In the Power Electronics course, the fairness and effectiveness of project-based assessments hinge on detailed, well-defined guidelines and transparent evaluation criteria. For the practical project aimed at assessing CLO2, the lecturer should provide clear instructions on both team selection and project specifications. Team formation should be conducted impartially, either by randomly assigning students to teams or by systematically selecting names from a class list. This approach ensures that teams are formed without bias, promoting fairness and diversity within each group.

Additionally, the project guidelines must include a precise specification of the power electronics devices that students are required to use or develop as part of their project. These specifications should detail the types of circuits, power components, and any other relevant technologies that students must incorporate into their designs. This not only sets clear expectations but also ensures that all students are working with the same foundational requirements, levelling the playing field. The instructor must also provide a detailed scoring rubric that aligns with these specifications. This rubric should clearly outline the criteria for scoring, such as design complexity, efficiency, innovation, adherence to technical specifications, and overall functionality of the final product. By referring to the rubric throughout the project, students can better understand how their work will be evaluated and what aspects of their design carry the most weight in their final score.

By setting clear team selection processes, precise project specifications, and transparent evaluation criteria through the use of the rubric, the instructor ensures that the assessment is not only fair but also a true reflection of each student's understanding and capabilities in power electronics. This structured approach fosters an equitable learning environment and directly supports the educational objectives of the course.

4.4. Equity

Ensuring equity in testing requires proactive strategies to mitigate disparities and provide all test takers with fairness and equality of opportunities, regardless of their diverse backgrounds or specific needs. Accessible test design is crucial; for example, in the Power Electronics course, tests can be made accessible by providing circuit diagrams in both standard and tactile formats, offering exams in Braille, or using audio descriptions for those who need them. Accommodations, such as extra time or the use of assistive technology should also be available. Additionally, test content should be culturally relevant and inclusive, avoiding biases towards any cultural group. In Power Electronics, this might mean using examples from various global contexts and ensuring that technical language is clear and neutral. Equitable scoring is another key aspect, where a clear scoring rubric is used to objectively assess elements like circuit design accuracy and implementation efficiency.

Further promoting equity involves standardised test administration, ensuring that all students in the Power Electronics course have access to identical tools and equipment under the same conditions. Bias reduction is also critical, involving the review of test items to eliminate any unconscious biases that might favour certain groups. Equitable access to preparation resources is essential; providing all students with workshops, simulation software, and previous exam

papers can help level the playing field. Transparency and accountability in the testing process are vital, with clear communication about how grades are determined and opportunities for student feedback. Lastly, continuous evaluation and improvement based on data and feedback will ensure that testing methods remain fair and effective, adapting to the needs of all students and maintaining rigorous standards in educational assessment.

4.5. Variety

Ensuring a variety of assessment strategies in test designs is essential for effectively assessing a diverse range of skills and knowledge to cater to different learning styles and cognitive abilities. One effective approach is to use multiple question formats such as multiple-choice, true/false, short answer, essay, and fill-in-the-blank. This variety allows for the evaluation of different cognitive skills such as recall, comprehension, and application. Additionally, it's important to cover a broad range of topics within the subject area, ensuring that questions vary in difficulty and complexity. This not only challenges high achievers but also supports learners at all levels.

For example, in the Power Electronics Lab, various assessment strategies can be introduced through real-world scenarios where students apply circuit theory to solve practical problems, reflecting actual situations they might face in the field. Performance tasks could include designing and testing power circuits, using simulations to predict outcomes, or constructing prototypes, which assesses application and analysis skills. Visual aids such as circuit diagrams and waveforms can be incorporated into test questions, enhancing understanding and engagement. Furthermore, open-ended questions can push students to demonstrate higher-order thinking by explaining their design choices or predicting the behaviour of a circuit under different conditions. By integrating these varied assessment strategies, a Power Electronics Lab can provide a comprehensive and meaningful evaluation of students' abilities, preparing them for real-world engineering challenges.

4.6. Constructive Alignment

Constructive alignment (CA) is a design for teaching in which what it intends that students should learn, and how they should express their learning, are clearly stated before teaching takes place (Biggs, 1999). It is an approach to curriculum design and delivery in which learning outcomes, teaching and learning activities and assessment are integrated to create the conditions for high-level learning. Teaching is then designed to engage students in learning activities that optimise their chances of achieving those outcomes, and assessment tasks are designed to enable clear judgments as to how well those outcomes have been attained.

According to the principle of constructive alignment for course design and delivery, the three elements (i) assessment tasks, (ii) teaching and learning activities, and (iii) intended learning outcomes must be aligned to each other (See Figure 3). This means that the students are expected to engage in activities that are meaningful and relevant to them, and that help them construct their own understanding of the content. The assessment tasks are designed to measure and evaluate the learning outcomes that the course intends to achieve. By aligning these three elements, constructive alignment promotes a deep and active learning approach rather than a surface-level and passive one.

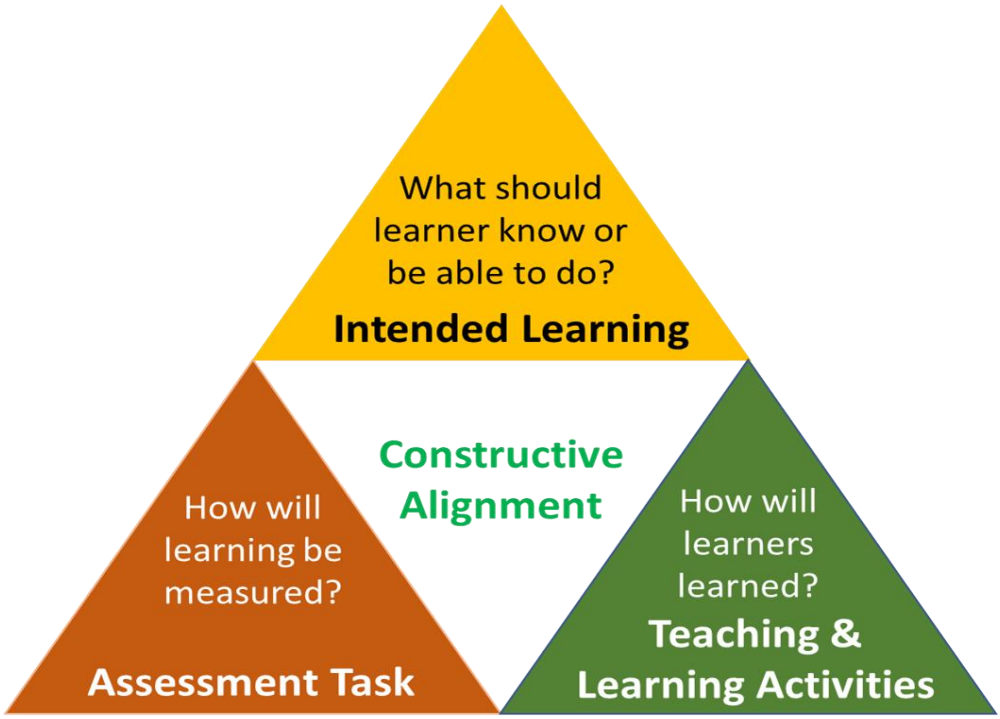

Figure 3: The Principles of Constructive Alignment for Course Design and Delivery

This means that the curriculum is designed to help students achieve the intended learning outcomes through appropriate and varied activities and tasks, and that the assessment methods are consistent with the outcomes and activities. The student is the main actor in this approach, as he or she actively builds his or her own knowledge. The instructor's role is to design learning activities that enable this and match what the student is supposed to learn. The course instructors must make sure that the learning outcomes are clear, the activities are aligned with the outcomes, and the assessment tasks are suitable ways of getting students to show what they have learned (See Appendix A). When these three elements are consistent and reinforce each other, students are likely to participate in educational tasks that maximises their chance of engaging in appropriate learning activities.

4.7. Ensuring Coverage and Alignment of Assessment to CLOs

As stated in Section 4.1, content validity can be confirmed by developing a course assessment plan and a table of test specifications (also referred to as a test blueprint). Instructors can ensure that assessments are aligned to the CLOs and can accurately measure student learning.

4.7.1. Course Assessment Plan and Course Plan

Course Assessment Plan (CAP) serves as a comprehensive document outlining the assessment strategies within a course, ensuring alignment with learning outcomes and facilitating meaningful student learning outcomes. The plan may include key components such as topics, teaching learning activities, defined learning outcomes, assessment strategies, and the weighting of assessment (see Table 5). The CAP must be endorsed by a course committee, dean of faculty/head of department or programme coordinator. HEIs are encouraged to have their own standardised template and guidelines for the course assessment plan. It also ensures that all outcomes are assessed according to the emphasis in the teaching. For more detail, the complete example of CAP for Power Electronics course is in Table 8.5 in Section 8.1.

Table 5: Template for Course Assessment Plan

CLOs	CLO statement	PLO Mapping	Assessment Techniques	Weighting (%)	T&L Strategy	Level of Learning (C/A/P*)	Topics			SLT (h)
							1	2	3	

C – Cognitive, A – Affection, P – Psychomotor*

Apart from the course assessment plan, instructors must develop a Detail Course Syllabus (DCS) or a course plan. The DCS is a detailed work plan according to weeks in the semester (see Table 6). Instructors must ensure the alignment between the outcomes, assessment and teaching and learning delivery. An example of a Detail Course Syllabus is as shown in the Appendix A. This template can be modified according to the needs of the HEIs. It can be further detailed out according to the week.

Table 6: Sample Template for Detail Course Syllabus or Course Plan

Week	Hours (L/T/P*)	CLOs	Lesson Learning Outcomes	Topic	Teaching Activity	Learning Activity	Assessment Techniques	T&L Resources
1								
2								
…								

L – Lecture, T – Tutorial/Seminar, P – Practical* (HEIs can categorise the learning activities based on their practices)

Regular review and revision of course assessment plan and course plan, along with a centralised repository for storage, contribute to the effectiveness of the course. Clear communication about the importance of the plan to all stakeholders underscores their role in enhancing the quality of education and promoting student success.

4.7.2. Table of Test Specifications (ToS) or Test Blueprint

A Table of Test Specifications (ToS) is a tool used by instructors to ensure that classroom tests are well-aligned with the curriculum, teaching objectives, and the instruction delivered. Its primary purpose is to frame the test construction process in a way that improves the validity of instructor evaluations based on these tests. ToS maps out how CLOs, instruction, and assessments should align. This alignment ensures that tests measure an adequate sampling of class contents and the cognitive levels identified in the CLOs and was taught.

The need for a ToS arises from the frequent mismatch between classroom activities and the material assessed on tests. Such discrepancies can lead to unfair evaluations where students are tested on content that was either not covered sufficiently in class or assessed at a different cognitive level than what was taught. A ToS helps prevent this by ensuring that the content and cognitive processes evaluated through tests reflect what was emphasised during instruction, thereby supporting the validity of the assessment. Table 7 shows a template for ToS. An example of ToS for the Power Electronics Course is provided in Appendix B.

Table 7: Template of Table of Test Specifications

Week	Topics	CLOs	SLT*	Assessment Techniques	Learning Domain	Cognitive level						Question number	Weighting	Total score
						C1	C2	C3	C4	C5	C6			

* SLT – student learning time

5. Assessment Techniques

As stated in Requirement 4.1 in Criterion 4 of AUN-QA. 'A variety of assessment methods is shown to be used and are shown to be constructively aligned to achieving the expected learning outcomes and the teaching and learning objectives'. Thus, HEIs/instructors shall determine assessment techniques to measure students' learning outcomes and to ensure the achievement of the PLOs and CLOs. Assessment techniques refer to evaluation methods and instruments utilized by instructors to assess students' learning outcomes. Utilising various assessment methods ensures a more comprehensive evaluation of student learning outcomes, accommodating different learning styles and providing multiple avenues for students to demonstrate their knowledge and skills.

5.1. Types of Assessment Techniques

There is a wide range of assessment techniques used to enhance student learning and to ensure students are assessed across a range of abilities, in which students have opportunities to showcase their strengths and identify areas that require improvement to enhance their performance. A well-developed course-level assessment strategy can ensure that the range of assessment conducted in the course provides opportunities for all students to gradually develop and demonstrate a full range of knowledge, skills, competences and graduate attributes. As a guide, the following Table 8 provides instructors with examples of assessment techniques based on intended learning outcomes and expected students' attributes. This can be used to determine which of the assessment techniques listed is suitable for the intended learning outcomes.

Table 8: Selected Assessment Techniques According to Intended Learning Outcomes

Intended Learning Outcomes	Expected Students Attributes	Links for examples
Thinking critically and making judgements	Development of arguments, reflection, judgement, evaluation	Essay-variants: articles and reviews, Portfolio, Reports Simulations
Solving problems/ developing plan	Identify problems, define problems, analyse data, review, design experiments, plan, apply information	Group work, Work-based Objective tests: short answer Essay-variants: articles and reviews Essay-variants: briefing / policy papers, Simulations

Performing procedures and demonstrating techniques	Take readings, use equipment, follow procedures and protocols	Lab notebooks and reports Performance, Film production
Demonstrate knowledge and understanding	Recall, describe, report, identify, recognize, recount	Oral presentations Objective tests: short answer Reflection: journals Concept maps, Reports
Developing self-directed learning, team work skills, time management skills	Work cooperatively and independently, be self-directed, manage time and tasks	Reflection: journals Portfolio, Group work Patchwork, Class participation
Designing, creating, performing	Design, create, perform	Oral presentations, Performance Film production
Assessing and managing information	Information search, retrieval, investigate, interpret, evaluate information	Annotated bibliographies Concept maps, Posters Essay-variants: research proposal,
Communicating	Written, oral and visual	Essay-variants: all Oral presentations Class participation, Group work Posters, Concept maps

As shown in Table 8, there are many assessment techniques that instructors may use to assess their students' knowledge, skills and competencies. The following are more examples of useful and commonly used assessment techniques.

- **Quizzes:** It is widely used to measure students' learning by many instructors in higher education. It is used to assess students' knowledge and understanding of specific content. Instructors can have many forms of quizzes, including short-answer, multiple-choice, true/false, fill-in-the-blank, matching, or essay-based. For example, instructors ask students to complete multiple prompts with multiple answers, where more than one prompt can be matched with the same answer.
- **Observations**: Instructors observe students during class activities, taking notes of their participation, behaviour, and skills. Observation has a variety of forms of methods, including checklists, rubrics, anecdotal records, conferences and rating scales. Instructors may use different methods based on the purpose, the context and time availability. For example, instructors use rubrics to evaluate students' performance-based criteria and levels of performance set for assessment.
- **Project:** Project-based assessment is a method to test students when participating in learning in a more concrete way. It also enables instructors to assess students' higher-order thinking skills when engaging in the complex projects or tasks related to their course work and the experience gained throughout the time frame of the class. A hands-on project is given to them to apply what they have learned to an in-depth exploration of a topic. Individual or small-group projects enable instructors to assess students' ability to apply acquired knowledge and skills. Students demonstrate skill such as problem-solving ability in solving authentic, real-world tasks or challenge-based tasks without a predetermined solution.
- **Portfolio:** Portfolio or e-portfolio is an on-going process, in which students collect and compile information about their learning to reflect their performance and ability over

time to show their progress, and the learning process is based on a marking standard in order to decide their performance or a study programme. The learning products are called learning artifacts. Therefore, portfolio or e-portfolio is a compilation of the learning artifacts for that can be used for assessment. For example, instructors ask students to collect work products such as collections of essays, etc. to demonstrate work achievement or accomplishment over a specific period of time. Instructors use rubrics and scoring guides to score portfolios.

- **Presentation:** It is a direct measure used to assess students' capacity in oral presentation and knowledge application. Instructors may use presentation to assess students' ability to design and organize contents in the presentation, to deal with questions and discussion, to synthesise feedback, and to demonstrate and manage presentation in the given time. For this assessment, instructors can ask any questions and request responses depending on the situation. Oral presentation could be used with recorded elements of audio and video tapes made by students. For example, instructors can require students to work individually or in a group to study on a particular topic, prepare and deliver oral presentation on the topic, either individually or in the team.
- **Peer assessment:** It is information from peer feedback on the quality of other students' work. Peer assessment allows students to assess other students in the team as well as themselves; allow the students to gain experience with giving and receiving feedback and give them an opportunity to improve performance. Peer assessment provides data that might be used in assigning individual grades for team assignments.
- **Self-assessment**: Refers to a process of formative assessment during which learners reflect on the quality of their work, judge the degree that reflects explicitly stated goals of criteria and revise accordingly. Students respond in writing to criteria set for evaluating their learning using critical reflection.
- **Group assessment**: Refers to a group of students that collaboratively works together to solve a complex task which needs proper planning, discussion, research, and presentation either during the class or over a certain period outside of the class. Instructors will monitor students by following the progress of the group and the contribution of individual students within a group.
- **A take-home test/assignment:** A task assigned to students individually or in groups as part of the course. It assists instructors in measuring students' understanding and application of knowledge to more complex tasks rather than memorising. For example, instructors can ask students to demonstrate their ability to synthesise information, or write a reflection or essay, or prepare a presentation.
- **Simulation or Role play:** Simulation is like experiential learning for students (Caniglia, 2019). Students are actively engaged in practical and real situations and challenged to solve problems through applying their knowledge or what they have learnt in an authentic manner. Students will work with other students to take on roles to achieve common goals. Students perform in a simulated real-life situation by applying and integrating knowledge and skills. For example, in preparation for simulation of an event/a scenario, instructors form students to work as a team and ask each team to assign roles they would like to play based on the roles needed in the team. Instructors can keep offering challenges, recommendations, questions or scenarios to the team for further consideration while doing the simulation.
- **Interview:** A technique used when assessing learners' understanding through oral questioning. The instructor conducts the interview for assessment purposes. So, it is not about students conducting an interview to gain information, but it is about the assessment of the students' oral response as well as the students' learning styles and preferences. Instructors may have the following methods:
    - **One to one interview**: a face to face interview during which questions may flow from students' responses; allows for a more complete assessment than pre-set questions. It is useful in combination with portfolio assessment.

    - **Panel interview:** Students are interviewed by several examiners.
- **Journals and Reflective Writing:** Assignments that encourage students to reflect critically on the process of learning and their development over time. It may describe events, experiences or issues associated with learning, professional placement, and fieldwork. For example, the instructor may ask students to identify two or three challenges that they faced while at field work and how they dealt with and learnt from those challenges.
- **Standardised written exam:** Exam designed in a way that the questions, conditions for administering, scoring procedures, and interpretations are consistent and are administered and scored in a predetermined, standard manner; often designed by using multiple choice questions and true or false format.
- **Case study:** It is used to assess students' ability to identify and analyse a complex and unknown situation. For example, in the course 'Power Electronics', the instructor may ask students to select the most effective method to predict power electronics reliability between use of Field Data Analysis and Reliability Prediction Software. To predict the reliability of power electronics, it involves assessing the likelihood of failure or degradation over time. There are two methods that can be used to predict power electronics reliability including Field Data Analysis (monitoring key parameters such as temperature, voltage, current, and operating hours) and Reliability Prediction Software (utilise mathematical models, algorithms, and historical data to predict the reliability of power electronics systems). The students are asked to perform the two methods, upload the information/data in google drive and compare the results then make a conclusion on the most effective method.

5.2. Processes in Assessment Design

Decisions and considerations around assessment design are critical to ensure that assessment supports learning (Gibbs & Simpson, 2005). Gibbs and Simpson (2005) outlined steps to be undertaken to promote thinking around the various stages and contexts of assessment, and to support the design and implementation of learning-centred assessment that stimulates learning and provides feedback.

Step 1: Consider the context of assessment

Assessment design and practice cannot be considered in isolation but need to be situated in the context of the overall programme of study; professional bodies' requirements; students' prior experiences and backgrounds; disciplinary culture; institutional policies; and learning environments.

Step 2: Consider the relationship between learning outcomes and assessment

Assessment should align with intended learning outcomes, although assessment can be designed to develop learners in broader ways than the specific learning outcomes. At this stage it is also important to verify that the learning outcomes identified can be assessed, and that the way in which they are written makes explicit precisely what will be evaluated through assessment.

Step 3: Consider how best to assess those outcomes

Select assessment methods and tasks that are valid, that is that they are able to measure how well students have achieved the intended learning outcomes. Implementing a range of assessment methods can contribute to a more meaningful learning experience and provide different ways for students to demonstrate that they have achieved the learning outcomes.

Step 4: Decide how much and when is most appropriate to assess

The amount and timing of assessment are important considerations in ensuring fairness. These must be addressed at the design stage and need to be considered both within the individual courses and across the whole programme.

Step 5: Building in opportunities for feedback
Both formative and summative assessment should be seen as a vehicle for providing opportunities for learning, therefore in designing assessment tasks consideration should be given to the opportunities which will be provided for students to obtain feedback.

Step 6: Building students' understanding of assessment (assessment literacy)
Assessment literacy develops student understanding of the nature, purpose, and methods of assessment, and the criteria and standards against which their work is evaluated. This enables students to develop as independent learners and to improve their performance.

Step 7: Review and evaluation
An important part of the assessment design and implementation cycle is the gathering and review of feedback and evidence to ensure that the assessment approaches and processes you have adopted are effective.

Step 8: Sense check
The prompts for critical thinking that accompany each of the steps above have hopefully encourage you reflect on the rational for your choices in assessment design and on the quality of the assessment procedures on your courses.

6. Marking Tools for Assessment

In ensuring consistency, fairness, and transparency in grading, the instructor must rely on tools which may be readily available or may need to be developed based on the criteria identified important for the assessment. In criterion-referenced, standards-based assessment, several tools that can be used are as follows:

1. Answer scheme
2. Rubrics
3. Rating scales
4. Checklists

6.1. Answer Scheme

Answer scheme is used in grading exams or tests. An answer scheme, also known as a marking guide or key, outlines the correct answers and the distribution of marks for each question. Table 9 shows step-by-step guide to develop an effective answer scheme:

Table 9: Guide to Develop Answer Scheme

Steps to Develop the Scheme	Descriptions
Identify the question types	Understand the types of questions (e.g., multiple choice, short answer, essays) and what skills or knowledge they are intended to test.
Identify Key Points	For each question, list the essential points in your test.
Allocate Marks	Decide how many marks each point.
Model Answers	Write full model answers for each question, highlighting the key points.
Mark Distribution	Clearly show the mark allocation for each part of the answer.
Peer Review	Have colleagues review the answer scheme to ensure it is clear and comprehensive.
Pilot Testing	Test the scheme on a sample of actual student responses to check for clarity and effectiveness.
Continuous Improvement	Use feedback from markers and students to adjust the answer scheme for future exams. Look for areas where the scheme was unclear or did not differentiate effectively between levels of student performance.

Examples of answer schemes

Question: Explain the process of evaporation.
Answer scheme:
Evaporation is the process by which water changes from liquid to gas or vapor. (1 mark)
It occurs at the surface of the liquid. (1 mark)
Energy (heat) is absorbed by the water molecules, increasing their kinetic energy. (1 mark)
When the molecules have enough energy, they escape into the air as gas. (1 mark)
Evaporation is a key part of the water cycle. (1 mark)

Question: Let $f(x)=x^3-3x^2+4$, find the critical points of $f(x)$. (5 marks)
Answer scheme:
Find the derivative of f(x): $f'(x)=3x^2-6x$ (1 mark)
Set the derivative equal to zero to find critical points: $3x^2-6x=0 \implies 3x(x-2)=0$. (1 mark)
Solve for x: $x=0$ or $x=2$. (1 mark)
List the critical points: Critical points are $x = 0$ and $x= 2$. (1 mark)

Question: Discuss the impact of early childhood attachment on later social and emotional development. Include key theories and research findings in your answer.

Sample Answer:

- Introduction: Brief overview of attachment theory.
- Attachment Theory: Description of Bowlby's and Ainsworth's contributions.
    - Bowlby's Theory: Attachment as a biological need for survival; stages of attachment.
    - Ainsworth's Strange Situation: Secure, avoidant, and ambivalent attachment styles.
- Impact on Development: Explanation of how different attachment styles influence later relationships, emotional regulation, and social competence.
    - Secure Attachment: Leads to healthier relationships, better emotional regulation.
    - Insecure Attachment: Associated with difficulties in relationships, higher risk of mental health issues.
- Research Findings: Summary of key studies, such as longitudinal studies by Mary Main and others linking attachment styles with later outcomes.
- Conclusion: Recap of the importance of early attachment and its long-term effects.

Marking Scheme:

- Introduction and context (5 points)
- Explanation of attachment theory (10 points)
- Discussion of impacts on development (10 points)
- Relevant research findings (10 points)
- Conclusion and synthesis (5 points)
- Quality of writing (clarity, coherence, and grammar) (5 points)

6.2. Rubrics

For subjective questions including essays or open-ended responses, a rubric needs to be used in the grading. It outlines criteria such as clarity, accuracy, depth of understanding, and organization of the answers. For the various learning domains incorporated in the curriculum, rubrics need to be used in assessing aspects such as interpersonal skills, responsibility, entrepreneurial skills, ethics and professionalism and communication.

Rubrics are used to assess students' work against criteria and standards. There are different types of rubrics such as holistic, analytic/descriptive, checklist and single-point. The clear rubrics inform students about the element's markers are looking for and the different levels of performance they can achieve. Rubrics also guide instructors in making fair and transparent judgments about students' achievement of learning outcomes. Generally, a rubric consists of the three following components. Figure 4 shows an example of a rubric.

i. **Criteria:** Specific aspects of the assignment that are being evaluated, including content, organization, grammar.
ii. **Levels of Performance:** Different levels of achievement for each criterion, often with descriptive labels (e.g., Excellent, Good, Satisfactory, Needs Improvement).
iii. **Descriptors:** Detailed descriptions of what each performance level looks like for each criterion.
iv.

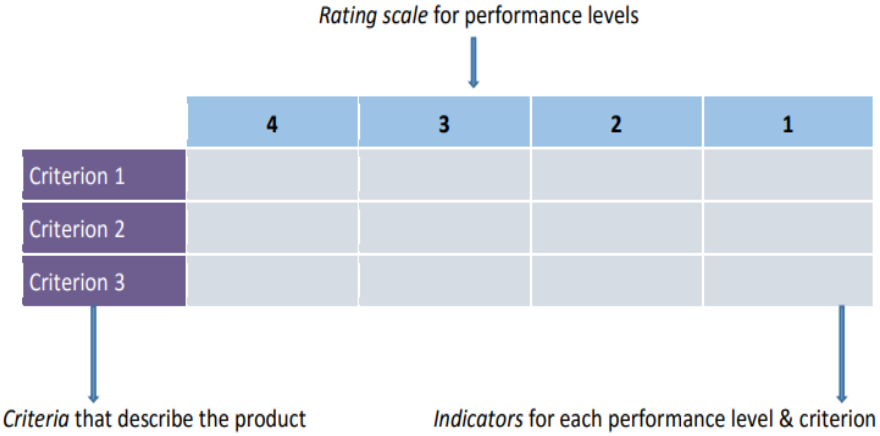

Figure 4: Components of a Rubric

6.3. Developing Marking Criteria

Instructors may consider to include the following aspects and steps when developing a rubric for marking.

Step 1: Analyse the assignment

Instructors analyses the assignment or assessment to create the rubric. Instructors need to consider the following questions:

- What is the purpose of the assignment and the feedback required?
- Does the assignment break down into different or smaller tasks?
- What would an "excellent" assignment look like?
- How detailed is the feedback to be given to students?

Step 2: Decide the kind of rubric to use

There are three types of rubrics. Instructors may decide which the following rubric will be used.

i. Holistic Rubric: A holistic rubric includes all the criteria (such as clarity, organization, mechanics, etc.) to be considered together and included in a single evaluation (see Table 10).
ii. Analytic/Descriptive Rubric: An analytic or descriptive rubric often takes the form of a table with the criteria listed in the left column and with levels of performance listed across the top row. Each of the criteria is scored individually (see Table 11).
iii. Single-Point Rubric: A single-point rubric is broken down the components of an assignment into different criteria, but instead of describing different levels of performance, only the "proficient" level is described (see Table 12).

Step 3 (Optional): Look for templates and examples
It is optional. Instructors can search any templates and example of rubrics in the website, for example, "Rubric for persuasive essay at the college level". However, instructors make sure that the rubric created matches their assignment description, learning objectives and expectations.

Step 4: Define the assignment criteria
Make a list of the knowledge and skills that will be measured with the assignment/assessment to achieve stated learning objectives.

Step 5: Design the rating scale
Most ratings scales range between 3 and 5 levels. Given what students are able to demonstrate in this assignment/assessment at different possible levels of achievement. Use numbers and/or descriptive labels for each level of performance such as 5, 4, 3, 2, 1 and/or Exceeds expectations, Accomplished, Proficient, Developing, Beginning.

Step 6: Write descriptions for each level of the rating scale
For a single-point rubric, describe what would be considered "proficient," i.e. B-level work, and provide that description. Instructors might also include suggestions for students outside of the actual rubric about how they might surpass proficient-level work.

For analytic and holistic rubrics, instructors create statements of expected performance at each level of the rubric. For an analytic rubric, do this for each particular criterion of the rubric so that every cell in the table is filled. These descriptions help students understand your expectations and their performance in regard to those expectations. Well-written descriptions:

- Describe observable and measurable behaviour
- Use parallel language across the scale
- Indicate the degree to which the standards are met

Step 7: Create your rubric
Create your rubric in a table or spreadsheet in Word, Google Docs, Sheets, etc.

Step 8: Pilot-test your rubric
Prior to implementing the rubric on a live course, obtain feedback from colleagues, teaching assistants and students. Try out the new rubric on a sample of students' work. After pilot-testing the rubric, analyse the results to consider its effectiveness and revise accordingly.

Table 10: Example of a Holistic Rubric for a Final Paper

Articulating thoughts through written communication— final paper.

Above Average: The audience is able to easily identify the central message of the work and is engaged by the paper's clear focus and relevant details. Information is presented logically and naturally. There are minimal to no distracting errors in grammar and spelling.

Sufficient: The audience is easily able to identify the focus of the student work which is supported by relevant ideas and supporting details. Information is presented in a logical manner that is easily followed. The readability of the work is only slightly interrupted by errors.

Developing: The audience can identify the central purpose of the student work without little difficulty and supporting ideas are present and clear. The information is presented in an orderly fashion that can be followed with little difficulty. Grammatical and spelling errors distract from the work.

Needs Improvement: The audience cannot clearly or easily identify the central ideas or purpose of the student work. Information is presented in a disorganized fashion causing the audience to have difficulty following the author's ideas. The readability of the work is seriously hampered by errors.

Table 11: Example of an Analytic Rubric for a Final Paper

	Above Average (4)	**Sufficient (3)**	**Developing (2)**	**Needs improvement (1)**
Clarity 60% (Thesis supported by relevant information and ideas)	The central purpose of the student work is clear and supporting ideas always are always well-focused. Details are relevant, enrich the work.	The central purpose of the student work is clear and ideas are almost always focused in a way that supports the thesis. Relevant details illustrate the author's ideas.	The central purpose of the student work is identified. Ideas are mostly focused in a way that supports the thesis.	The purpose of the student work is not well-defined. A number of central ideas do not support the thesis. Thoughts appear disconnected.
Organization 20% (Sequencing of elements/ ideas)	Information and ideas are presented in a logical sequence which flows naturally and is engaging to the audience.	Information and ideas are presented in a logical sequence which is followed by the reader with little or no difficulty.	Information and ideas are presented in an order that the audience can mostly follow.	Information and ideas are poorly sequenced. The audience has difficulty following the thread of thought.
Mechanics 20% (Correctness of grammar and spelling)	Minimal to no distracting errors in grammar and spelling.	The readability of the work is only slightly interrupted by spelling and/or grammatical errors.	Grammatical and/or spelling errors distract from the work.	The readability of the work is seriously hampered by spelling and/or grammatical errors.

Table 12: Example of Single-point Rubric

Advanced (evidence of exceeding standards)	**Criteria described a proficient level**	**Concerns (things that need work)**
	Criteria #1: Description reflecting achievement of proficient level of performance	
	Criteria #2: Description reflecting achievement of proficient level of performance	
	Criteria #3: Description reflecting achievement of proficient level of performance	
	Criteria #4: Description reflecting achievement of proficient level of performance	
90-100 points	**80-90 points**	**<80 points**

6.4. Assigning Marks for Rubrics

Assigning grades and marks are very important. Instructors need to think carefully about how to convert achievement against criteria and standards into a 'mark' or grade, in a way that is valid and reliable. To be valid, the outcome needs to accurately reflect the quality of the work; thus, the holistic professional judgement plays crucial role.

Using marks and weightings: The first approach assigns a weighting to each criteria and awards marks for each standard of performance (See example in Table 13)

Table 13: Example of Assigning Weighting to Each Criterion and Providing Marks

Criteria	Excellence	Very Good	Good	Pass	Fail
Criterion 1 (40%)	Description (35-40 marks)	Description (30-34 marks)	Description (25-29 marks)	Description (20-24 marks)	Description (0-19 marks)
Criterion 2 (40%)	Description (35-40 marks)	Description (30-34 marks)	Description (25-29 marks)	Description (20-24 marks)	Description (0-19 marks)
Criterion 3 (20%)	Description (17.5-20 marks)	Description (15-17 marks)	Description (12.5-14.5 marks)	Description (10-12 marks)	Description (0-9 marks)
Total marks					

6.5. Rating Scales

A rating scale for assessing assignments is a useful tool to ensure consistency and fairness in grading. It breaks down the assignment into specific criteria and assigns a range of marks for each criterion based on performance levels. A rating scale is a simpler assessment tool as compared to a rubric. It assigns a numerical or descriptive value to different aspects of performance. Rating scales can be used for a wide range of tasks but are typically less detailed than rubrics. More examples of rating scale are in Appendices C, D, E, F, G and H.

A rating scale is a tool used for assessing the performance of tasks, skill levels, procedures, processes, qualities, quantities, or end products, such as reports, drawings, and computer programs. These are judged at a defined level within a stated range. Rating scales are similar to checklists except that they indicate the degree of accomplishment rather than just yes or no.

Table 14: Example of Rating Scale for Assessing Interpersonal Skills

COMM 0001 – Business Communications

Objective: The student will demonstrate the ability to work well with other people.

Criteria for success:

Each statement must be at a level of "Average" or better.

Instructor:_____ Date: _____

Student name:_____ Student ID: _

Team Skills	Poor 1	Weak 2	Average 3	Good 4	Excellent 5
People skills					
Communication skills					
Contribution to the work done					
Contributions to meetings					
Arrives on time to meetings					
Based on team agreement, place a check mark in the appropriate box in each row.					
Comments:					

6.6. Characteristics of Rating Scales

Rating scales should:

i. Have criteria for success based on expected outcomes.
ii. Have clearly defined, detailed statements.
iii. Have statements that are chunked into logical sections or flow sequentially.
iv. Include clear wording with numbers when a number scale is used.
v. For example, when the performance statement describes a behaviour or quality, 1 = poor through to 5 = excellent is better than 1 = lowest through to 5 = highest or simply 1 through 5.
vi. The range of numbers should be the same for all rows within a section (such as all being from 1 to 5).
vii. The range of numbers should always increase or always decrease. For example, if the last number is the highest achievement in one section, the last number should be the highest achievement in the other sections.
viii. Have specific, clearly distinguishable terms. For example, using good then excellent is better than good then very good because it is hard to distinguish between good and very good. Some terms, such as often or sometimes, are less clear than numbers, such as 80% of the time.
ix. Be short enough to be practical.
x. Highlight critical tasks or skills.
xi. Indicate levels of success required before proceeding further, if applicable.
xii. Have a column or space for providing additional feedback.
xiii. Have space for other information such as the student's name, date, course, examiner, and overall result
xiv. Be reviewed by other instructors.

6.7. Numeric Rating Scales

When assigning numbers to each column for marks in a rating scale, instructors shall consider the following:

i. What should the first number be? If 0, does the student deserve 0%? If 1, does the student deserve 20% (assuming *5* is the top mark) even if he/she has done extremely poorly?
ii. What should the second number be? If 2 (assuming 5 is the top mark), does the person really deserve a failing mark (40%)? This would mean that the first two or three columns represent different degrees of failure.
iii. Consider variations in the value of each column. Assuming 5 is the top mark, the columns could be valued at 0, 2.5, 3, 4, and 5.
iv. Consider the weighting for each row. For example, for rating a student's report, should the introduction, main body, and summary be proportionally rated the same? Perhaps, the main body should be valued at five times the amount of the introduction and summary. A multiplier or weight can be put in another column for calculating a total mark in the last column.

6.8. Checklists

A checklist is a tool for identifying the presence or absence of conceptual knowledge, skills, or behaviours. Checklists are used for identifying whether key tasks in a procedure, process, or activity have been completed. The tasks may be a sequence of steps or include items to verify that the correct sequence was followed. The instructor may need to observe that the tasks are followed. In general, the instructor cannot judge what tasks the learner did by looking only at the end product. It may also involve attitudes that may be observed indirectly. For example, safety attitudes can be observed by seeing if safety equipment is worn.

A checklist may also be given to students to follow in completing a procedure (e.g., in a shop or lab). A checklist itemizes task descriptions in one column and provides a space beside each

item in a second column to check off the completion of the task. Table 15 shows an example of a checklist. The checklist is used to check whether the students are able to write learning outcomes that have a measurable action verb at the highest appropriate level. The student is considered to meet the outcome if all questions are answered 'yes'.

Table 15: Checklist for Task on Writing Learning Outcomes

Yes	No	Writing Learning Outcomes
☐	☐	Does each outcome include an action verb?
☐	☐	Is only one action verb used in each outcome?
☐	☐	Is each outcome measurable?
☐	☐	Is each outcome written in terms of what the learner does, not what the instructor does?
☐	☐	Is each outcome clear from the learner's perspective?

* Must get all 'yes' to indicate ability to write good learning outcomes.

Characteristics of checklists are as follows:

1. Have criteria for success based on expected outcomes
2. Be short enough to be practical (e.g., one sheet of paper)
3. Have tasks chunked into logical sections or flow from start to finish
4. Highlight critical tasks
5. Have sign-off points that prevent students from proceeding without approval, if needed
6. Be written with clear, detailed wording to minimize the risk of misinterpretation
7. Have space for other information such as the student's name, date, course, examiner, and overall result
8. Be reviewed by other instructors

7. Assessment of Learning Outcomes

Assessment is a process of gathering evidence that the learning outcomes (LO), which are the expected performance or competence level, have been achieved when students completed a course or graduated from a programme. The assessment process for LOs follows the PDCA cycle:

1. **Plan**: Develop assessment plans based on OBE principles and Learning Outcomes, covering both course-level and programme-level assessments.
2. **Do**: Implement assessment plans every semester, using direct and indirect assessment methods based on norm referenced, non-criterion reference, formative and summative assessment.
3. **Check**: Monitor the Assessment Process, compute results, and analyse them.
4. **Act**: Analyse differences between expected and actual improvements, and act to address areas for improvement, such as curriculum changes or redefining outcomes.

Assessing LO in Outcome-Based Education (OBE) is pivotal for ensuring the quality and efficacy of educational programmes. This assessment operates across three interconnected levels. As shown in Figure 5, it commences at the course level, focusing on Course Learning Outcomes (CLOs), which are evaluated at the conclusion of each semester. The achievement of CLOs serves as a basis for inferring attainment at the programme level. Programme Learning Outcomes (PLOs) are crafted to encompass the attainment of individual students and cohorts within the semester. The assessment and ongoing monitoring of both CLO and PLO attainment span the entirety of the study programme. This continuous quality improvement (CQI) process involves promptly addressing areas where outcomes have not been met, ultimately guiding students to fulfil all PLOs by the programme's culmination. Through this

iterative approach, educational programmes evolve to produce graduate's adept in meeting established learning outcomes.

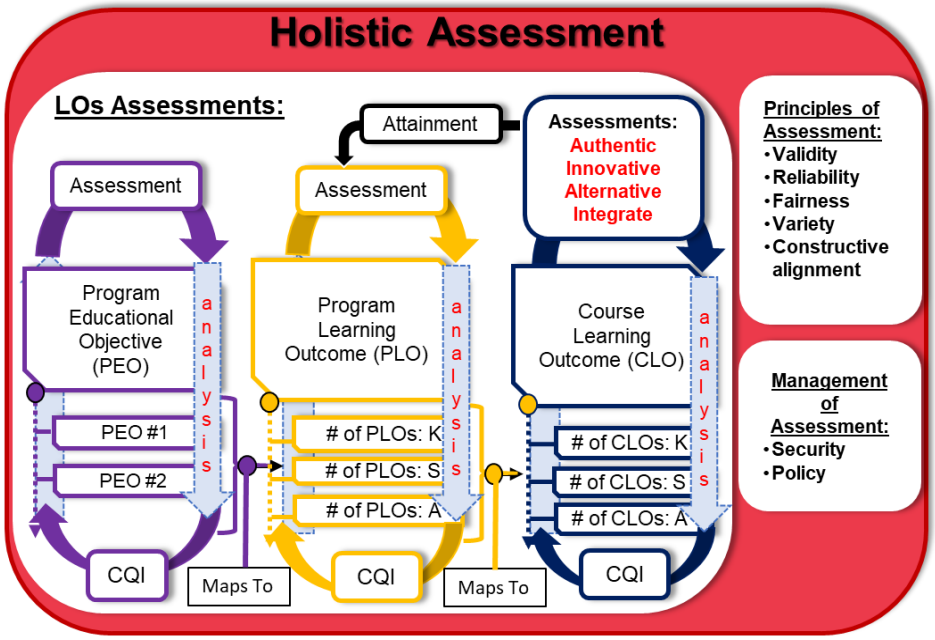

Figure 5: Interconnectedness between Assessments of CLO, PLO and PEO

In Figure 6, the assessment of Programme Educational Objectives (PEOs) occurs approximately three to five years post-graduation, aiming to evaluate the degree to which alumni are achieving these objectives as they navigate their careers or pursue advanced education. Data utilised in assessing PEOs encompass alumni surveys, feedback from employers, and the systematic tracking of graduates' career trajectories. While this guideline primarily addresses the assessment of Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs), it's important to note that the evaluation of PEOs is detailed out in the Guideline for Transformative Curriculum Design (GTCD).

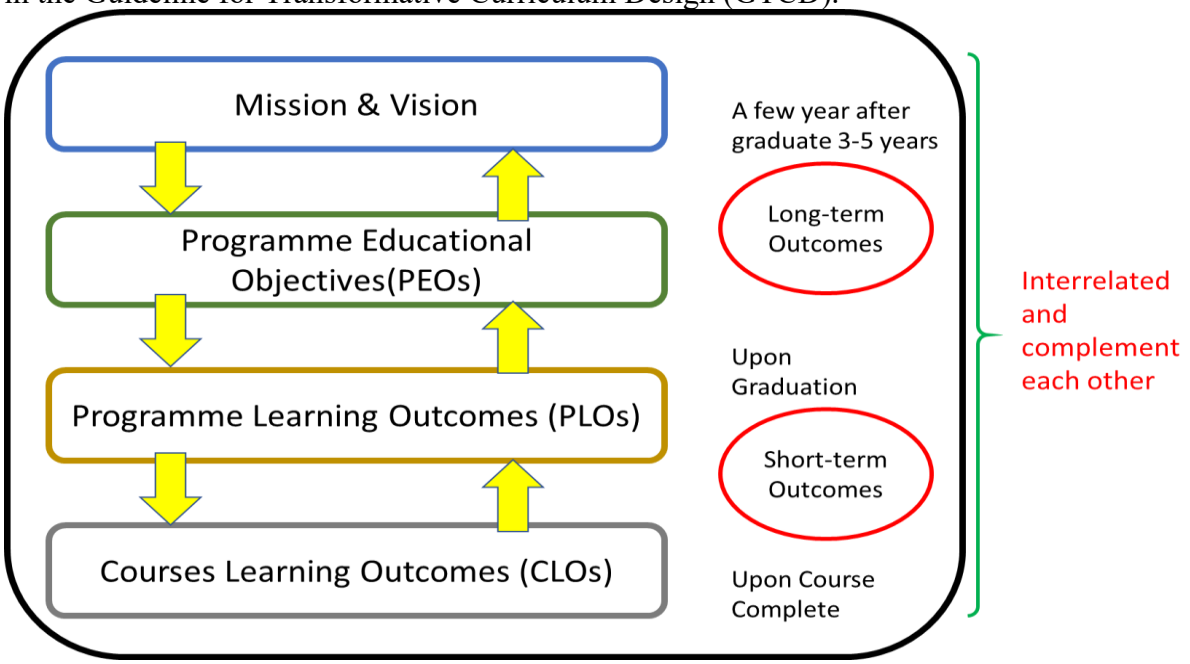

Figure 6: Assessments of Learning Outcomes at Different Levels

This section encompasses three primary components; the assessment of Course Learning Outcomes (CLOs), the assessment of Programme Learning Outcomes (PLOs), and the

methodologies for determining the attainment of both CLOs and PLOs. Additionally, it offers examples of assessment tasks to assist instructors in their assessment processes. These examples serve as practical guide to ensure clarity and consistency in assessment practices across courses and programmes.

7.1. Assessment of Course Learning Outcomes for Different Domains

This section discusses how to assess the CLO in the cognitive, psychomotor and affective domains as described in the revised Bloom's taxonomy for learning domains. Samples of selected assessment techniques, assessment tasks, assessment criteria and assessment rubrics will be illustrated in the section as examples for instructors to use for assessment of learning.

Students' learning needs to be assessed for all the major domains (MD) and learning domains (LD) as stated in the Guideline on Transformative Curriculum Design (GTCD). As a recap, based on the Cambodian Qualification Framework (CQF), there are five MDs of learning outcomes that are linked to all learning levels, including (i) knowledge – MD 1, (ii) cognitive skills – MD 2, (iii) psychomotor skills – MD 3, (iv) interpersonal skills and responsibilities – MD 4, and (v) communication, information technology and numeric skills – MD 5. In the GTCD, these five major domains are further classified into ten LDs, namely, (i) knowledge – LD 1, (ii) cognitive skills – LD 2, (iii) psychomotor skills – LD 3, (iv) interpersonal skills – LD 4, (v) responsibility – LD 5, (vi) entrepreneurial skills – LD 6, (vii) ethics and professionalism – LD 7, (viii) communication – LD 8, (ix) information technology or digital skills – LD 9, and (x) numerical skills – LD 10. Do take note that ICT skills and numerical skills can be classified into two categories which are knowledge (MD1) and psychomotor/technical skills (MD3), depending on the focus. In terms of the revised Bloom's Taxonomy, the MDs and LDs can be classified into three domains of learning, which are (i) cognitive domain (six levels), (ii) psychomotor domain (seven levels), and (iii) affective domain (five levels) (see Table 16). The levels in those three domains indicate the depth of the learning required since the levels are hierarchical. Having to cover the 10 LDs for each academic programme shows the 'width' required in producing the kind of graduates that we need as indicated in FEF.

Table 16: Alignment between KSA and CQF Learning Domains (MDs and LDs)

<table>
<tr><th colspan="2">Revised Bloom's Taxonomy</th><th colspan="2">CQF learning domains</th></tr>
<tr><th>Domain</th><th>Levels</th><th>Major Domain (MD)</th><th>Learning Domain (LD)</th></tr>
<tr><td rowspan="2">Knowledge (Cognitive) (K)</td><td rowspan="2">6</td><td>MD1: Knowledge</td><td>LD1: Knowledge</td></tr>
<tr><td>MD2: Cognitive skills</td><td>LD2: Cognitive skills</td></tr>
<tr><td>Psychomotor/ Technical Skills (S)</td><td>7</td><td>MD3: Psychomotor/Technical skills</td><td>LD3: Psychomotor/Technical skills</td></tr>
<tr><td rowspan="4">Affective (Attitude) (A)</td><td rowspan="4">5</td><td rowspan="4">MD4: Interpersonal skills and responsibility</td><td>LD4: Interpersonal skills</td></tr>
<tr><td>LD5: Responsibility</td></tr>
<tr><td>LD6: Entrepreneurial skills</td></tr>
<tr><td>LD7: Ethics and Professionalism</td></tr>
<tr><td colspan="2" rowspan="3">K/S/A*</td><td rowspan="3">MD5: Communication, information technology, and numerical skills</td><td>LD8: Communication*</td></tr>
<tr><td>LD9: Information technology or digital skills *</td></tr>
<tr><td>LD10: Numerical skills *</td></tr>
</table>

In the GTCD, a list of action verbs recommended for the three domains of learning in Bloom's Revised Taxonomy is provided. The subsection on writing learning outcomes provides suggested verbs aligned with the levels of taxonomies, which can be instrumental in crafting

both learning outcomes (LOs) and assessment tasks. By utilizing these verbs, instructors can ensure alignment between what students are expected to achieve and how their understanding will be evaluated. This alignment enhances the validity and effectiveness of assessments in measuring student learning accurately and comprehensively.

7.2. Assessment of the Cognitive Domain

In assessment of the cognitive domain (MD 1 – knowledge and MD 2 – cognitive skills), instructors must assess up to the level specified in the CLO. The six levels of knowledge (cognitive domain) to be acquired by students according to the revised Bloom's Taxonomy are as follows; remembering – C1, understanding – C2, applying – C3, analysing – C4, evaluating – C5, and creating – C6. Instructors shall develop suitable assessment techniques for assessing the specific level of knowledge, and decide on the most suitable teaching and learning methods in achieving those outcomes. For example, to assess the level of remembering (C1), instructors shall use questions such as multiple-choice questions (MCQ), fill in the blanks, labelling, matching, etc. However, when assessing the level of creating, students need to be given tasks such as project, problem-based learning, product development or performance tasks. The level of creating involves demonstration of students' ability to generate new ideas or products.

Table 17 is the exhibit table to present an illustration of an assessment task to assess students' ability to create (C6) in the knowledge domain. The course owner had designed the CLO to measure students' capabilities in MD1- C6, MD2, MD5 - LD8. Consequently, the project used in assessing this CLO is graded based on three specific criteria.

NOTE: The following table 17, 19 and 21 are the exhibit tables to demonstrate assessments for CLO that incorporate several domains (cognitive, psychomotor or affective domains and few MDs and LDs) which will require several criteria used in the assessment. However, if the course owner had designed the course and meant for the CLO to only focus only on one aspect, then he/she will only need to map the CLO to one domain or MD. Hence, the assessment task will be assessed only on one criterion.

Table 17: Example of Assessment Task for the Cognitive Domain

Example of a project to assess level of creating (C6).

This project should be able to assess students' ability to create a comprehensive proposal. Apart from that, it can be used to assess their research skills, critical thinking, collaboration, and presentation abilities. It also provides an opportunity for students to apply theoretical knowledge to real-world problems and develop practical solutions.

CLO - At the end of the course, students can propose a project to implement a sustainable energy solution in a real-world context (MD1- C6, MD2, MD5 - LD8).

Task description

Work in groups of threes. Develop a proposal for implementing a sustainable energy solution in a real-world context, such as a community, business, or campus. You need to research various sustainable energy sources, analyse their environmental impact, economic feasibility, and potential for widespread adoption.

Present the proposal using an appropriate presentation tool.

Note: The CLO focuses on MD1- C6, MD2, MD5 - LD8. Hence assessment should encompass the following criteria:

i. Proposal that reflects the depth of research and understanding of sustainable energy concepts (MD1 - C6 Creating) - 50%
ii. Clarity and coherence of the proposal, including feasibility and potential impact (MD2 - Critical Thinking) – 30%
iii. Creativity, organization, and effectiveness of the presentation (LD8 - communication skills) – 20%

The following Table 18 illustrates samples of assessment methods suitable for the cognitive domain according to the levels in the revised Bloom's Taxonomy. The detailed samples of assessment tasks are in Appendix I.

Table 18: Sample of Assessment Methods for the Cognitive Domain

Domains	Major Domain (MD)	Learning Domain (LD)	Learning Level	Selected Assessment Methods
Cognitive	1. MD1: Knowledge 2. MD2: Cognitive skills	1. LD1: Knowledge 2. LD2: Cognitive skills	C1: Remembering	Multiple choice questions (MCQs) (terms, facts and concepts) Fill in the blank (terms, facts and concepts) Labeling Short answer test Writing test Performance test Matching, Presentation (Summarising, reciting) Puzzles
			C2: Understanding	MCQs, Short answer test (compare and contrast two or more theories, process), Presentation (interpreting or explaining information) Class discussion, Essay Posters, Paraphrasing information, Writing test
			C3: Applying	Performance (class activity, role play) Project, Posters Practicum/field work Simulation, Case studies (real-life problem and proposed a solution) Lab experiment Case study
			C4: Analysing	Essay writing Written report Portfolios, Debates Case studies, SWOT Performance test, Project Presentation (Problem with multiple cause and determine the most likely cause), Research

			C5: Evaluating	Written test, Debates Mock court, Essay Experiment, Project Performance test Case study
			C6: Creating	Presentation, Essay Journal, Report writing Prototype or model Composition Performance tasks Research, Project Business plan

7.3. Assessment of the Psychomotor Domain

For the psychomotor domain, instructors may aim to assess the seven levels of psychomotor/technical skills that students should acquire. As described in the revised Bloom's Taxonomy, the levels are perception (P1), set (P2), guided response (P3), mechanism (P4), complex overt response (P5), adaptation (P6), and origination (P7). The levels to be assessed are based on the level specified in the CLO for psychomotor skills (LD3) and teaching and learning methods. However, in the CQF, it is stated that the focus on LD3 in the course is optional. Nevertheless, course designers should try to include LD3 so as to produce balanced individuals and graduates with the full skills set.

In assessing a specific CLO, instructors may need to utilise a variety of assessment techniques. For instance, when assessing students' ability at the level of origination for the psychomotor domain, the instructor may require students to engage in a product development project or create a portfolio, but the focus should be on assessing students' psychomotor/technical abilities, such as abilities to develop a new product, generating ideas or solutions. On the other hand, if the product development project is used to assess the cognitive domain, then the focus is on students' demonstration of knowledge and thinking in working on the project.

Table 19 presents an illustration of an assessment task to assess students' demonstration of skill at the level of complex overt response (P5) of the psychomotor domain. The course owner had designed the CLO to measure students' capabilities in MD1 - C4, MD3 - P5, MD4 - LD5. Consequently, the crop planting and management project is used in assessing this CLO is graded based on three specific criteria; (i) problem-solving (MD2), (ii) technique proficiency (MD3 - - P5) and (iii) team work (MD4 – LD5).

Table 19: Example of Assessment Task for the Psychomotor Domain

Example of a task to assess level of complex overt response (P5)
CLO - At the end of the course, students are able to demonstrate their ability to apply knowledge of crop management techniques, use appropriate tools and equipment, and perform tasks accurately and efficiently in crop planting and management (MD2, MD3 - P5, MD4 - LD5).
Task description
Form groups of four people. In the designated plot assigned to your group,

- Prepare the land for planting, including soil cultivation, levelling, and amendment as necessary
- Plant a variety of crops according to specified planting guidelines
- Set up irrigation systems to provide adequate water to planted crops
- Apply fertilizers as needed Implement measures to control pest and disease that affect the crops.

Note: The CLO focuses on MD2, MD3, and MD4 - LD5. Hence assessment should encompass the following criteria:

i. Problem-Solving: The ability to identify and address challenges related to soil preparation, irrigation, fertilization, and pest management (MD2 - problem solving) – 30%
ii. Technique Proficiency: The ability to perform crop planting and maintenance tasks accurately and efficiently (MD3 - psychomotor/technical skills - P5) – 50%
iii. Team work: The ability to determine division of labour and work cooperatively in managing the farm (MD4 – LD5) – 20%

The following Table 20 illustrates samples of assessment techniques suitable for the psychomotor domain according to the levels in the Bloom's Taxonomy. Detailed sample assessment tasks are in Appendix I.

Table 20: Sample of Assessment Methods for the Psychomotor Domain

Domains	Major Domain (MD)	Learning Domain (LD)	Learning Level	Selected Assessment Methods
Psychomotor/ Technical Skills	1. MD3: Psychomotor/ Technical skills 2. MD5: Communication, information technology, and numerical skills	1. LD3: Psychomotor skills/ Technical Skills 2. LD9: Information technology or digital skills 3. LD10: Numerical skills	P1: Perception	Presentation Practical work, Puzzle Summarise
			P2: Set	Performance test Role-playing Presentation, Report
			P3: Guided response	Presentation Progress report Performance test Draft/draw sample
			P4: Mechanism	Set up experiment Presentation Measuring data, Information, Report
			P5: Complex over response	Set up more complex experiments Construct modelling (mini scale for testing in lab), Solve/fix error Report

			P6: Adaptation	Modify model/prototype Presentation, Report
			P7: Origination	Portfolio Building model/ prototype Presentation Report Article Publication

7.4. Assessment of the Affective Domain

In assessing the affective domain, instructors must aim to assess the five levels to be acquired by students as described in the revised Bloom's Taxonomy which are receiving (A1), responding (A2), valuing (A3), organizing (A4), and internalising (A5). To assess the learning outcome, instructor shall develop assessment methods based on the level to be assessed. For example, to assess the level of internalising (A5), the instructor shall adopt assessment methods such as role play, essay, posters, reflective journals, projects, presentation, research, etc. but the focus is on tapping the students' attitude, emotion and values.

Table 21 presents an illustration of an assessment task to assess students' demonstration of internalising (A5) of the affective domain. The course owner had designed the CLO to measure students' capabilities in MD2, A5 - LD7, LD8, and LD5. Hence various criteria are used in the assessment, (i) Ethical Analysis (MD2 - analytical thinking), (ii) Justification and Argumentation: (MD2 - reasoning), (iii) Reflection and Self-Awareness (A5, LD7 - ethics and professionalism) and (iv) Communication Skills (LD8).

Table 21: Example of Assessment Task for the Affective Domain

Example of a project to assess level of internalising (A5)
CLO - At the end of the course, students are able defend ethical implications of engineering decisions (MD2, A5 - LD7, LD8).
Task description
In groups of threes, conduct a case study analysis focusing on ethical dilemmas and moral reasoning in engineering practices. You are required to critically evaluate case scenarios, consider the ethical implications of engineering decisions, reflect on their personal values and ethical principles, and articulate the perspectives and justifications in written or oral presentations.
Note: The CLO focuses on MD2, A5 - LD7, and LD8. Hence assessment should encompass the following criteria:

i. Ethical Analysis: The depth and rigor of students' ethical analysis of case scenarios, including identification of ethical issues, application of ethical principles, and consideration of consequences (MD2 - analytical thinking - 30%
ii. Justification and Argumentation: The clarity, coherence, and persuasiveness of students' ethical reasoning and justification for their proposed courses of action. (MD2 - reasoning) - 20%
iii. Reflection and Self-Awareness: The depth and insightfulness of students' reflections on their personal values, beliefs, and ethical responsibilities as future engineers. (LD7 - ethics and professionalism) - 30%
iv. Communication Skills: The effectiveness of students' written or oral presentations in conveying their ethical perspectives and engaging others in constructive dialogue (LD8 - communication) – 20%

The following Table 22 illustrates samples of assessment methods suitable for the affective domain according to the levels in the Bloom's Taxonomy. Detailed sample assessment tasks are in Appendix I.

Table 22: Selected Assessment Methods According to Domains and Learning Levels

Domains	Major Domain (MD)	Learning Domain (LD)	Learning Level	Selected Assessment Methods
Affective	1. MD4: Interpersonal skills and responsibility 2. MD5: Communication, information technology, and numerical skills	1. LD4: Interpersonal skills 2. LD5: Responsibility 3. LD6: Entrepreneurial skills 4. LD7: Ethics and Professionalism 5. LD8: Communication	A1: Receiving	Quiz, MCQ, Puzzle Face to face oral Summary report Written exam Project
			A2: Responding	Project (group) Lab experiment Presentation, Quiz
			A3: Valuing	Long project Case study Written exam Quiz, Presentation
			A4: Organi-sing	Project Case study Poster Written exam Debate Prototype
			A5: Internali-sing	Role play Essay Posters Project Presentation Prototype Performance Task Journal Research

Upon designing assessment tasks to assess the CLOs, instructors must establish clear assessment criteria and assign the weighting to each criterion as demonstrated in the examples of tasks provided in Table 17, 19 and 21). The examples show that multiple domains (MDs and LDs) may contribute to each CLO. Therefore, the assessment criteria should encompass all domains to be assessed.

Students should be informed of the assessment criteria so that they can adequately prepare for the tasks. It will help them to effectively work on the tasks towards meeting the set standards. When grading the tasks, it is essential to develop rubrics or modify existing ones to ensure unbiased judgment and scoring. Further explanation and illustration on creating effective rubrics can be found in the Section 6.

Below is a description and the CLOs for a course on Power Electronics (See Table 23 as Exhibit), offered in the final year of the Electronics and Automation (EA) and Electrical Energy (EE) programme. Assessments designed for this course are detailed out in Appendix

H, which include the assessment methods, assessment tasks, assessment criteria and assessment rubrics that are developed based on the CLOs and domains to be assessed.

Table 23: Example of Course Description and CLOs for a course on Power Electronics

Course description: This course is to provide the fundamental concept of a power electronics system that can convert AC/DC voltage to another AC/DC voltage level. A detailed description of power electronics devices is also provided for forming the power converter.
At the end of the course, students would be able to:

CLO 1: apply basic knowledge of power electronics components, power electronics structure, and its application in Electronics and Automation (EA) and Electrical Energy (EE) fields (MD1, LD1, C3)

CLO 2: design a suitable and economical power electronics converter for requirement specification (MD2, LD2, C6, P7)

CLO 3: develop teamwork skills, presentation skills and technical writing skills appropriate for scientific and non-scientific communities (MD4, LD8, A4)

For assessing lower levels of the three domains of learning for the same course, instructors can develop assessment techniques based on the CLOs set in the course syllabus and domains to be assessed. Some examples of assessment tasks according to levels of learning domains are shown in Appendix I.

8. Assessment of Programme Learning Outcomes

Assessment of PLOs can be done directly as has been the practice of some institutions. Direct assessment methods include exit exams, portfolios and performance assessments. Culminating experiences such as capstone projects or thesis also provide opportunities for students to demonstrate mastery of PLOs through comprehensive and in-depth projects.
Some institutions rely on the use of external assessment methods, such as the following:

i. Standardised Tests: Some programmes use standardised tests or exams developed by external organisations to measure student achievement of PLOs. These tests provide benchmarks for comparison with peer institutions.
ii. Professional Certification Exams: For programmes preparing students for specific professions or industries, certification exams serve as external measures of PLO attainment.
iii. Accreditation Reviews: External accreditation agencies often evaluate educational programmes based on their alignment with established standards and the achievement of PLOs.

In the case of Cambodian HEIs, it is recommended that attainment of PLOs is to be demonstrated through assessments that are incorporated in courses within the programme. Assessments integrated into course activities and assignments allow for ongoing monitoring of student progress in achieving the PLOs. These assessments provide timely feedback to both students and instructors, hence facilitating continuous improvement. As shown in Figure 5 and Figure 6 in Section 7, PLO attainment can be inferred from the attainment of the CLOs.

Based on the MoEYS' guidelines and playbooks on Holistic assessment, HEIs or academic programs shall develop their own policy to ensure clear mechanism and procedure for student assessment. This section focuses on PLOs attainment at the programme level in order to ensure PLO achievement. However, to evaluate students' score for the use of the transcript purpose, HEIs may use their existing GPA or HEIs may use iCGPA to align with OBE to ensure a comprehensive evaluation. Assessment standards policy shall include credit system; grading system; policy on retention, discontinuation of studies, dropping out of courses; regulations on absence; requirements for thesis/dissertation; policy on comprehensive exams; eligibility for graduation; and policy on plagiarism. HEIs can adopt MoEYS' guidelines and playbooks to develop their own mechanism and policies. To ensure the system work, HEIs and each

academic programme shall have competent and sufficient resources, including instructors and program owners to make system work to implement holistic assessment.

Before starting to perform the CLOs and PLOs assessments, each programme has to clearly define its PLOs and the PLOs-Courses matrix. According to the CQF and the GTCD, every programme should include a minimum of 10 PLOs, which covers the five main domains. The PLOs correspond to the 10 learning domains (LDs). To better understand the attainment of PLOs, a five-year programme for Electronics and Automation (EA) Engineering is provided as an example for the whole section. This programme contributes to 10 PLOs. An example of a list of the 10 PLOs of the programme that correspond to each LD, is shown in Table 24.

Table 24: Programme Learning Outcomes (PLOs) of the Electronics and Automation (EA) Engineering programme

MD1		PLOs	Knowledge
K	LD1: Knowledge	PLO1	At the end of the EA programme, students are able to apply new knowledge in the fields of electronics and smart automation systems.
MD2		Cognitive Skills	
S	LD2: Cognitive skills	PLO2	On successful completion of the programme, students are able to design engineering products/solutions that meet the specified needs with consideration of social economic factors in the field of electronics and automation.
MD3		Psychomotor Skills	
S	LD3: Psychomotor skills	PLO3	Students are able to conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions in the scope of electronics and automation systems development.
MD4		Interpersonal and Responsibility skills	
S	LD4: Interpersonal skills	PLO4	By the completion of the EA programme, learners are able to develop a team or teamwork whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
A	LD5: Responsibility	PLO5	By the end of the EA programme, students are able to demonstrate professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
S	LD6: Entrepreneurial skills	PLO6	On successful completion of the EA programme, learners are able to identify business problems accurately and effectively across a wide range of business domains.
A	LD7: Ethics and professionalism	PLO7	Learners in EA programme are able to recognize ethical and professional responsibilities in the engineering context with consideration to the societal impacts.
MD5		Communication, information technology, and numerical skills	
A	LD8: Communication	PLO8	Students in EA programmes are able to apply written, oral, and graphical communication with appropriate usage of the technical literature.
S	LD9: Information technology or digital skills	PLO9	By the successful completion of the EA programme, students are able to use computer software for data analysis and solving complex problems.
S	LD10: Numerical skills	PLO10	Students in EA programme are able to use both quantitative and qualitative techniques to forecast the trend in electronics and automation.

8.1. Courses-PLO Mapping

To ensure that the courses within the programme contribute to the achievement of the PLOs, it is essential to establish a clear mapping between the courses and the PLOs. To determine the PLO attainment through assessments integrated in courses within the programme, instructors must start by mapping the CLOs to the PLOs. This mapping should be agreed upon at both the programme and department levels. It is not appropriate to simply assign a course to the PLOs without considering the suitability of the course.

Each course should contribute to a minimum of three PLOs, while certain courses such as Internship may have the potential to address all the PLOs. Additionally, the programme coordinator and the Head of Department have the responsibility to ensure that all PLOs in the programme are adequately addressed by the courses. Table 25 illustrates the mapping between all the courses in the EA programme to the PLOs. An elaborated version of PLOs to course mapping is discussed in GTCD.

The extent of contribution of courses to the PLOs varies, from fully (F) to moderately (M) or partially (P) (more detail in GTCD). The identification of P, F, or M determines the emphasis

on the specific PLO. This will also determine the allocation of time for teaching and learning activities, as well as the weighting for assessing the CLOs that are aligned to the PLOs. As a recommendation, fully (F) indicates a focus of more than 50% on this PLO in the course, moderate (M) indicates a focus of 31% - 50%, and partial (P) indicates a focus of less than 30% for the PLO.

Table 25: PLOs-Course Mapping

Year	Semester	Course Code	Course Title	Credit	Program Learning Outcomes (PLOs)									
					1	2	3	4	5	6	7	8	9	10
1	1	DTCI11KLC	Khmer Language for	2	P			P				F		
		DTCI11HAC	Humanity and Civilization	2	P				F		P			
⋮	⋮	⋮	⋮		⋮									
4	1	GEEI41FRE	French VII	1	P						M	P		
		GEEI41PEL	Power Electronics	3	F	P	P					P		
		GEEI41REM	Research Methodology	2	P			M	M		P			
		GEEI41MOD	Motor drive	3	P	P	M					P		
⋮	⋮	⋮	⋮		⋮									
5	1	GEEI51ELV	Extra-low voltage design	3		F	P							
	2	GEEI51WSP	Work-life and social psychology	1	P				M		M			
		GEEI52FYI	Final Year Internship	12	P	P	P	P	P	P	P	P	P	P
Total			63 Courses	144	F=13, M = 0, P = 48	F=1, M = 3, P = 20	F=4, M = 3, P = 26	F=0, M = 3, P = 7	F=1, M = 2, P = 5	F=1, M = 1, P = 1	F=0, M = 16, P = 5	F=1, M = 3, P = 19	F=0, M = 5, P = 11	F=0, M = 9, P = 8

In order to determine PLO attainment for the programme in each semester, it is essential to identify the contribution of all courses to each of the PLOs. Table 26 displays a comprehensive mapping between courses and PLOs in Semester 1 Year 4 of the EA programme. It is evident that all courses contribute either fully or partially to PLO1. None of the courses for the semester address PLO6, and only one course contributes to PLO5. According to GTCD, courses consist of four to five CLOs, which are then linked to the PLOs specified for the course. If only one CLO of the 'Research Methodology' course is associated with PLO5, then the achievement for PLO5 for the semester can be directly obtained from the CLO achievement linked to PLO5. However, if two or more CLOs are linked to PLO5 for this course, then the contribution of each must be considered in the calculation. The calculation process will commence from the course level in the subsequent section.

Table 26: Comprehensive Mapping of Course to PLO Mapping for One Semester

Year	**Semester**	**Course ID**	**Course**	**Credit**	**PLOs**									
					1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
4	1	GEEI41ENG	English V	1	P						M	P		
		GEEI41FRE	French VII	1	P						M	P		
		GEEI41PEL	Power Electronics	3	F	P	P					P		
		GEEI41REM	Research Methodology	2	P			M	M		P			
		GEEI41MOD	Motor drive	3	P	P	M					P		
		GEEI41MCS	Modern control systems	3	P		P						M	P
		GEEI41INP	Industrial network protocol	2	P		P						M	P
		GEEI41SPP	Student project part I	1	P		P	P					P	P

8.2. CLOs and PLOs Assessment at Course Level

In accordance with Figure 7, the instructors of all courses that teach the programme in that semester have the duty to produce a report to the programme head on the achievement of CLOs and PLOs in their respective courses. This aids the programme head in consolidating the PLOs achievement for the programme during that particular semester. Subsequently, the programme head will compile the PLO attainment report for the semester.

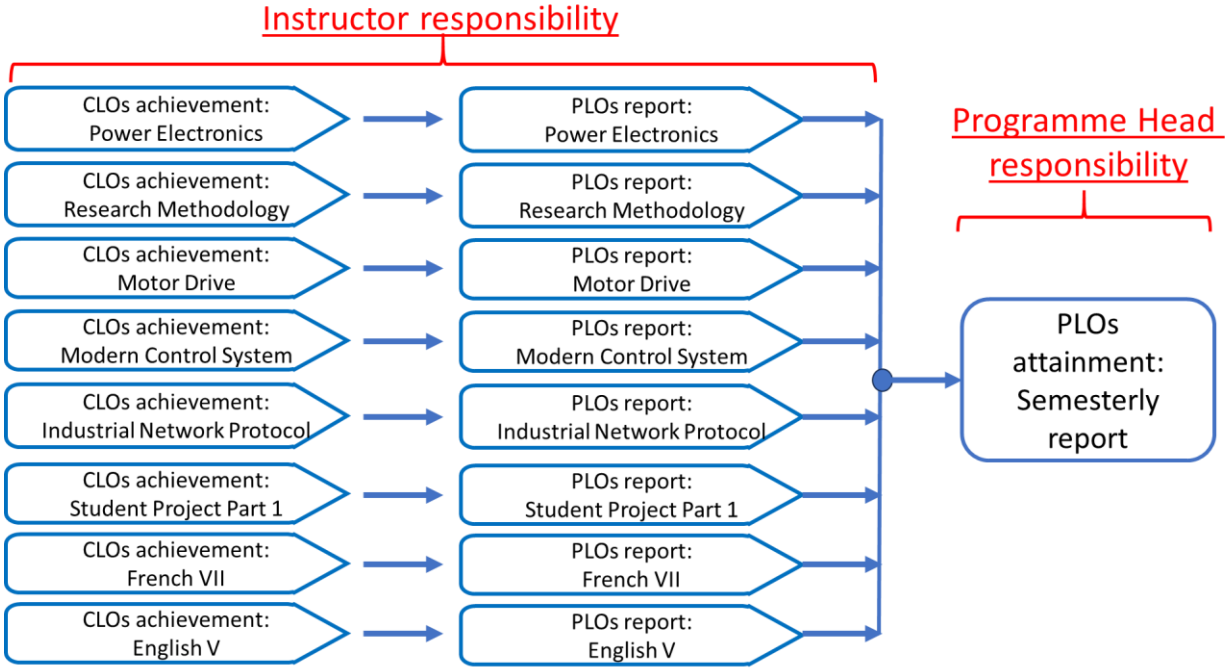

Figure 7: Process of Consolidating the Programme PLOs Attainment for the Semester

In this section, the detail about the CLOs assessment and PLOs assessment for a course will be provided in detail. The course, GEEI4PEL titled 'Power Electronics' offered in Year 4 is used to demonstrate the process of CLO assessment and PLOs assessment at the course level. This course comprises of three CLOs, as given in Table 27. Table 25 shows that this course is mapped to PLO1, PLO2, PLO3, and PLO8 respectively. The course's CLOs encompass Knowledge (K), Skill (S), Attitude (A), the learning domains (LDs), and the levels Bloom's taxonomy.

Table 27: CLOs of the Course 'Power Electronics'

Description of the course learning outcomes – CLOs At the end of the course, students are able to:	
CLO1 (K)	***Select*** the power electronics components and structures for suitable purposes. (MD1 – LD1, C4)
CLO2 (S)	***Design*** a suitable and economical power electronics converter for requirement specification. (MD2 – LD2, C6; MD3 – LD3, P6)
CLO3 (A)	***Develop*** effective communication skills of power electronics systems in scientific and non-scientific communities. (MD5 – LD8, A4)

Table 28 illustrates a detailed mapping of CLOs of the course to the PLOs. This is normally referred to as the CLO-PLO mapping. As a good practice, the instructor can identify the most dominant PLOs to be mapped to a specific CLO. Having too many PLOs mapped to a CLO will require gathering more evidences in determining the PLO attainment. The different percentages of CLOs to each PLOs is a very important key in determining the attainment of the PLOs.

Table 28: CLOs and PLOs Mapping of the Course 'Power Electronics'

CLO	Programme Learning Outcome									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	√ (F-50%)									
CLO2		√ (P-10%)	√ (P-15%)							
CLO3								√ (P-25%)		

8.2.1. Course Assessment Plan

Developing a Course Assessment Plan is a crucial process for course assessment. The instructors will need to determine the most suitable technique/s in assessing each CLO. The instructors should provide information on how each CLO is to be assessed, as well as planning for the most effective teaching and learning methods, and other key components as shown in Table 5 (Section 4). Apportionment of percentages or weighting of marks for each CLO needs to be proportionate to the SLT for the CLO. Detailed assessment plan for the course 'Power Electronics' offered in Semester 1 of Year 4 is shown in Table 29. As shown, the CLO1, CLO2, and CLO3 contribute to 50%, 25%, and 25%, respectively to the overall marks for the course.

Table 29: Detail Course Assessment Plan for the Course 'Power Electronics'

CLOs	CLOs statement	PLOs	Assessment Methods	Weightage (%)	T&L* Strategy/ Technique	Level of Learning (C/A/P*)	Topics			SLT** (h)
							1	2	3	
1	At the end of the course, students are able to ***select*** the power electronics components and structures for suitable purposes.	PLO1	Class Test 1	5%	Peer teaching	C4	√			60
			Class Test 2	5%				√		
			Midterm Exam	20%			√	√		
			Final Exam	20%				√	√	
2	At the end of the course, students are able Design a suitable and economical power electronics converter for requirement specification.	PLO2	Lab Prototype and report	10%	K-W-L	C6				30
		PLO3		15%		P7	√	√		
3	At the end of the course, students are able Develop effective communication skills of power electronics systems in scientific and non-scientific communities.	PLO8	Presentation and report	25%	PoBL	A4				30
*T&L: Teaching and Learning										
**SLT: Student Learning Time										

8.2.2. CLOs Assessment for a Course

CLOs is the attribute that students are expected to have after completing a course. The evaluation of whether CLOs are attained, is essential in determining a student's grasp of a particular course. The result of CLO attainment will also be used to evaluate the attainment of program learning outcomes (PLOs). The outcome of the analysis will be used to improve the teaching and learning experience in the particular course. Today the different approaches being used for CLO assessments include the average approach, threshold approach, and performance vector approach. The average approach is the most widely employed approach in the majority of courses. In the average approach, the average score of students must surpass the criteria for success. For instance, a HEI may decide that the average score for a CLO must be at least 50% to consider it as 'passing the CLO'. This threshold may vary between HEIs. It much depends on the proficiency level that they set for their students' mastery of the CLO.

Table 30 shows an example of CLO1 assessment for the course based on the score obtained by each student. To check the achievement of CLO1, scores of students from each criterion are added to the table, as seen in the Mark Criteria column of Table 30. The score is contributed in different weights as provided in the Course Assessment Plan. In practice, the instructor can

design the assessment with an exact full score, but he/she needs to convert it according to the percentage that was determined (the set weight score). A system to generate CLO and PLO attainment would be able to convert this score automatically. The instructor is required to provide students with feedback on their performance for each specific criteria, along with comments aimed at assisting them in addressing their weaknesses and achieving higher scores in future assessments.

The total score of each student for CLO1 can be calculated by summing the scores from each criterion, as seen in the Total Score column of CLO1. The condition of a student passing a CLO, as used by some HEIs is as follows: 'Student must have the total score of CLO greater or equal to 50% of maximum score'. For better understanding, let us see the result of Student A, who got only 20.25 over the maximum score of 50, which is 41%. This means that he/she failed CLO1. Nevertheless, the threshold score used can be changed according to the decision of the HEIs and faculty/department. For example, in some courses of engineering design, the student needs to be serious, so maybe 50% is too low as the condition for getting a pass. HEIs or faculty or departments can then decide to increase the threshold for passing to 60% or 70%.

Table 30: CLO1 Assessment for Power Electronics Course

Student ID	Student Name	Mark Criteria								Total		CLO 1 Pass/Fail	CLO1 Grade	CQI
		Class Test #1		Class Test #2		Midterm		Final						
		CLO score (5%)	Pass/ Fail	CLO score (5%)	Pass/ Fail	CLO score (20%)	Pass/ Fail	CLO score (20%)	Pass/ Fail	Score Max. 50	Score Max. in (%)			
IDxxxA	Student A	0.00	Fail	0.65	Fail	6.80	Fail	12.80	Pass	20.25	41%	Fail	E	
IDxxxB	Student B	2.80	Pass	2.85	Pass	10.80	Pass	17.40	Pass	33.85	68%	Pass	C+	
IDxxxC	Student C	2.30	Fail	4.30	Pass	13.00	Pass	17.80	Pass	37.40	75%	Pass	B	
IDxxxD	Student D	2.35	Fail	4.30	Pass	13.60	Pass	14.00	Pass	34.25	69%	Pass	C+	
IDxxxE	Student E	4.30	Pass	2.85	Pass	15.60	Pass	15.60	Pass	38.35	77%	Pass	B	
IDxxxF	Student F	4.45	Pass	2.80	Pass	19.40	Pass	17.80	Pass	44.45	89%	Pass	A	
IDxxxG	Student G	4.45	Pass	3.35	Pass	13.40	Pass	15.80	Pass	37.00	74%	Pass	B	
IDxxxH	Student H	3.90	Pass	3.90	Pass	17.80	Pass	15.60	Pass	41.20	82%	Pass	B+	
IDxxxI	Student I	4.85	Pass	3.40	Pass	19.60	Pass	13.40	Pass	41.25	83%	Pass	B+	
											# Fail	1	Avg. CLO Pass/Fail Condition	Avg. CLO Achievement
											# Pass	8		
											Fail %	11%	50%	Yes
											Pass %	89%		

After the result of each student for CLO1 is obtained, the instructor can now check the achievement of the CLO based on the number of students who passed (as the average method is suggested). Again, as shown in Table 30, eight of the nine students passed the CLO1 and only Student A failed. A CLO for a course is considered as attained/achieved '**if 50% of students get 50% marks for the CLO**'. In this case, 89% of students achieved CLO1. Since 89% of students passed CLO1 (getting more than 50% as in Score Max in % column), using the threshold set, which is 50%, hence CLO1 is considered as achieved. Similar to the passing criteria, this threshold can also be adjusted based on the decision of the HEIs and Faculty/Department. The same method is applied to determine attainment of CLO2 and CLO3.

Table 31 and Table 32 show the scores of the same students for CLO2 and CLO3. It is observed that the CLO2 of the course has an average CLO of only 44%, which indicates that

CLO2 is not achieved. The analysis of the achievement result will be discussed in the Section 8.2.3 below.

Table 31: CLO2 Assessment for Power Electronics Course

Student ID	Student Name	Mark Criteria										Total		CLO 2 Pass/ Fail	CLO2 Grade	CQI
		Select Device		Construct		Modeling PE		Coding		Prototypes						
		CLO score (5%)	Pass/Fail	CLO score (5%)	Pass/Fail	CLO score (5%)	Pass/Fail	CLO score (5%)	Pass/Fail	CLO score (5%)	Pass/Fail	Score Max. 25	Score Max. in (%)			
IDxxxA	Student A	0.00	Fail	0.00	Fail	0.00	Fail	2.15	Fail	2.75	Pass	4.90	20%	Fail	F	
IDxxxB	Student B	1.80	Fail	1.15	Fail	1.15	Fail	1.60	Fail	3.35	Pass	9.05	36%	Fail	F	
IDxxxC	Student C	2.15	Fail	2.00	Fail	2.00	Fail	2.75	Pass	3.35	Pass	12.25	49%	Fail	D	
IDxxxD	Student D	2.25	Fail	2.00	Fail	2.30	Fail	2.10	Fail	3.75	Pass	12.40	50%	Fail	D	
IDxxxE	Student E	3.30	Pass	3.80	Pass	2.00	Fail	3.80	Pass	3.25	Pass	16.15	65%	Pass	C	
IDxxxF	Student F	4.30	Pass	3.75	Pass	3.75	Pass	4.35	Pass	2.85	Pass	19.00	76%	Pass	B	
IDxxxG	Student G	2.80	Pass	1.00	Fail	1.00	Fail	3.40	Pass	2.85	Pass	11.05	44%	Fail	E	
IDxxxH	Student H	3.25	Pass	3.85	Pass	3.85	Pass	4.35	Pass	2.85	Pass	18.15	73%	Pass	B	
IDxxxI	Student I	2.35	Fail	4.35	Pass	4.35	Pass	4.85	Pass	4.30	Pass	20.20	81%	Pass	B+	
													# Fail	5	Avg. CLO Pass/Fail Condition	Avg. CLO Achievement
													# Pass	4		
													Fail %	56%	50%	No
													Pass %	44%		

Table 32: CLO3 Assessment for Power Electronics Course

Student ID	Student Name	Mark Criteria						Total		CLO 3 Pass/ Fail	CLO3 Grade	CQI
		Presentation		QA		Report						
		CLO score (5%)	Pass/ Fail	CLO score (10%)	Pass/ Fail	CLO score (10%)	Pass/ Fail	Score Max. 25	Score Max. in (%)			
IDxxxA	Student A	0.00	Fail	0.00	Fail	0.00	Fail	0.00	0%	Fail	F	
IDxxxB	Student B	1.80	Fail	2.30	Fail	5.70	Pass	9.80	39%	Fail	F	
IDxxxC	Student C	2.15	Fail	5.60	Pass	4.60	Fail	12.35	49%	Fail	D	
IDxxxD	Student D	2.25	Fail	5.60	Pass	6.70	Pass	14.55	58%	Pass	C	
IDxxxE	Student E	3.30	Pass	7.60	Pass	8.60	Pass	19.50	78%	Pass	B	
IDxxxF	Student F	4.30	Pass	7.50	Pass	5.70	Pass	17.50	70%	Pass	B	
IDxxxG	Student G	2.80	Pass	5.60	Pass	8.70	Pass	17.10	68%	Pass	C+	
IDxxxH	Student H	3.25	Pass	7.70	Pass	5.70	Pass	16.65	67%	Pass	C+	
IDxxxI	Student I	4.40	Pass	8.70	Pass	8.70	Pass	21.80	87%	Pass	A	
									# Fail	3	Avg. CLO Pass/Fail Condition	Avg. CLO Achievement
									# Pass	6		
									Fail %	33%	50%	Yes
									Pass %	67%		

8.2.3. Summary of CLO Attainment

This section discusses how to summarise the CLO attainment, again referring to the example on the 'Power Electronics' course. It is important for the course instructor to check the achievement of students after completing the course. As shown earlier, the Power Electronics course has three CLOs; CLO1, CLO2, and CLO3 where each CLO contributes to 50%, 25%, and 25%, respectively to the total marks for the course. Hence, the instructor can calculate the total marks for this course as the sum of the marks for the three CLOs. Table 33 displays the marks for CLO1, CLO2, and CLO3 for Student A to Student I, which are extracted from Tables 30, 31, and 32, respectively and also the total marks for all the CLOs in the course. The total marks for each student are as shown in the column 'Total Marks'.

As discussed in Section 8.2.2, CLO1 is achieved for the course but not CLO2 and CLO3. These total marks can be used to evaluate the students' result for this course as seen in the column 'Subject Pass/Fail' and 'Course Grade'. The CLO for the course is considered as attained/achieved '**if 50% of students get 50% marks for the total CLOs**' (see Total Marks column). Student A obtained below 50%. The CLO attainment for the course is considered as achieved as more than 50% of the students obtained more than 50% in the total marks for the three CLOs. Again, this threshold level can be adjusted by the HEIs and Faculty/Department according to the requirements of the programme or the expected achievement of the students.

However further analysis can be done. For example, to get 50% for CLO2, the students must get at least 12.5 of 25. In column CLO2, only 4 students of 9 (44%) got more than 12.5 (converted as 50%). As shown earlier in Section 8.2.2, the CLO2 and CLO3 are not achieved, but overall CLO for the course is achieved, which is greatly contributed by CLO1. In suggesting the continuous quality improvement (CQI) for the course, all these need to be analysed and interventions need to be planned for improvement.

Table 33: Determining CLO Total Marks and Course Grade

Student ID	Student Name	CLO Marks			Total Marks (100)	Subject Pass/Fail	Course Grade	CQI
		CLO1 (50)	CLO2 (25)	CLO3 (25)				
IDxxxA	Student A	20.25	4.90	0.00	25.15	Fail	F	
IDxxxB	Student B	33.85	9.05	9.80	52.70	Pass	C	
IDxxxC	Student C	37.40	12.25	12.35	62.00	Pass	C	
IDxxxD	Student D	34.25	12.40	14.55	61.20	Pass	C	
IDxxxE	Student E	38.35	16.15	19.50	74.00	Pass	B	
IDxxxF	Student F	44.45	19.00	17.50	80.95	Pass	B+	
IDxxxG	Student G	37.00	11.05	17.10	65.15	Pass	C+	
IDxxxH	Student H	41.20	18.15	16.65	76.00	Pass	B	
IDxxxI	Student I	41.25	20.20	21.80	83.25	Pass	B+	
					# Fail	**1**		
					# Pass	**8**		
					% Fail	**11%**		
					% Pass	**89%**		

8.2.4. Determining Grades for CLOs and Report Based on Average CLO

Grading is a way to show the result for students. The grading system varies between HEIs. In this example, a grading system from one HEI (Table 34) is provided as reference.

Table 34: Grading System of a HEI

Grade	Score Range (%)	Status
A	85%-100%	Excellent
B+	80%-84%	Very Good
B	70%-79%	Good
C+	65%-69%	Fairly Good
C	50%-64%	Fair
D	45%-49%	Poor
E	40%-44%	Very Poor
F	less than 40%	Failure

Table 35 shows the CLO attainment report for the course 'Power Electronics'. The 'Average CLO Marks' is extracted from Table 30 to Table 32. The analysis shows that CLO2 is not achieved and improvement actions need to be planned.

Table 35: Example of CLO Attainment Report

CLOs	Average CLO Marks	Achieved/ Not Achieved	Need Improvement	Improvement Action
CLO1	89 %	Achieved	No	
CLO2	44 %	Not Achieved*	Yes	Students are already in Year 4 Semester 1. Many have not shown satisfactory level of 50% in the ability to design a suitable and economical power electronics converter for requirement specifications. The level expected is C6 and P6 which should be realistic for students in Year 4. Actions planned: 1. Progress of the design needs to be discussed with the instructor every week. 2. Laboratory equipment needs to be more adequate to support students' work. 3. More design tasks should be given in the forthcoming semesters before the students graduate.
CLO3	67 %	Achieved	No	

***** Less than 50% of the students get less than 50% marks for CLO2.

8.2.5. PLOs Assessment for a Course

As discussed earlier in this Section 8, instructors need to report on the CLOs and PLOs assessment of their courses to the programme head. This section outlines the process for conducting PLOs assessment and the format of the required reporting.

As shown earlier, the CLO1 of Power Electronics is mapped fully (F) to PLO1, which is set as 50% of total score. It means that PLO1 score of each student is equal to their CLO1 score with the maximum score of 50. So, the average achievement of PLO1 obtained is as shown in

Table 36. A student is considered as passing PLO1 if he/she has PLO1 score of more than 50% of maximum PLO1 score. Student B who obtained 33.85 of 50 (about 68% of total score) passed the PLO1 but Student A who only obtained 20.25 of 50 (about 41% of total score) is considered as failing the PLO1. Results in Table 36 show that only one student of nine students in total failed the PLO1 which mean 89% passed the PLO1. So, PLO1 is considered as achieved.

Weight multiplies by Credit (weight x Credit) indicated in Row 2 of Table 8.13 is referred to as Credit Weight (CW). The contribution to PLO1 from this course to PLO1 for the whole programme in this semester needs to factor in the credit weight. Hence, the credit weight of PLO is for the purpose of calculating the attainment to a PLO for the semester, for the year or cumulatively for the programme at the end of the final year. This will be discussed in the next section. The credit weight is determined as the score weight of the CLO multiplies with the credit hours of the course. For instance, for CLO1, the score weight is 50% and it is a 3 credits course, thus the Credit Weight is equal to 1.5.

Table 36: Average Achievement of PLO1

Student ID	Student Name	PLO1 Score Report					
		CLO1	PLO1 Total		Pass/Fail (50%)	PLO1 Grade	CQI
		Score Wieght 50%	Score Max. 50	Score Max. in (%)			
Weight x Credit		50% x 3 = 1.5	1.5				
IDxxxA	Student A	20.25	20.25	41%	Fail	E	
IDxxxB	Student B	33.85	33.85	68%	Pass	C+	
IDxxxC	Student C	37.40	37.40	75%	Pass	B	
IDxxxD	Student D	34.25	34.25	69%	Pass	C+	
IDxxxE	Student E	38.35	38.35	77%	Pass	B	
IDxxxF	Student F	44.45	44.45	89%	Pass	A	
IDxxxG	Student G	37.00	37.00	74%	Pass	B	
IDxxxH	Student H	41.20	41.20	82%	Pass	B+	
IDxxxI	Student I	41.25	41.25	83%	Pass	B+	
				Fail	**1**	Avg. PLO Achieved Condition	Avg. PLO Achieved
				Pass	**8**		
				Fail %	**11%**	50%	Yes
				Pass %	**89%**		

As shown earlier in Table 28, only CLO1 contributes fully to a PLO, which is PLO1. Contribution of CLO2 to PLO2 is only 10% and to PLO3 for 15%, where the total contribution of CLO2 to the course is only 25%. With these weights, score of PLO2 is equal to 40% of CLO2 maximum score and PLO3 is equal to 60% of CLO2 maximum score as seen in Table 37 and 38, respectively. Based on this, we can calculate the PLO score of a student as follows:

$$Student's\ PLO_x\ score\ =\ Weight\ of\ CLO_x - PLO_x \times\ student's\ CLO_x\ score$$

Where, weight of CLO contributes to PLO

$$Weight\ of\ CLO_x - PLO_x = \frac{Weight\ CLO_x - PLO_x}{Weight\ CLO_x - Course}$$

Note that: Weight of $CLO_x - PLO_x = 1$, in case CLO is contributed only to a PLO.

For Credit Weight (CW), we can calculate in the same way as PLO1. For PLO2, CW = (% contribution of CLO2 to PLO2) x course credit = 10% x 3 = 0.1 x 3 = 0.3. CLO2 contributes

15% to PLO2, hence 0.15 x 3 = 0.45. Results in Table 8.14 show that PLO2 is not achieved. This call for CQI that may require discussion at the departmental level to improve the course in CLO2 as mentioned above. In the last example, Table 39 reveals that the result of average achievement of PLO8 is achieved with 67% of students passing this PLO.

Table 37: Average Achievement of PLO2

Student ID	Student Name	PLO2 Score Report					
		CLO2	PLO2 Score		Pass/Fail	PLO3 Grade	CQI
		Score Wieght 10%	Max. 10	100%			
Weight x Credit		10% x 3 = 0.3	0.3				
IDxxxA	Student A	1.96	1.96	13%	Fail	F	
IDxxxB	Student B	3.62	3.62	24%	Fail	F	
IDxxxC	Student C	4.90	4.90	33%	Fail	F	
IDxxxD	Student D	4.96	4.96	33%	Fail	F	
IDxxxE	Student E	6.46	6.46	43%	Fail	E	
IDxxxF	Student F	7.60	7.60	51%	Pass	C	
IDxxxG	Student G	4.42	4.42	29%	Fail	F	
IDxxxH	Student H	7.26	7.26	48%	Fail	D	
IDxxxI	Student I	8.08	8.08	54%	Pass	C	
				Fail	**7**	Avg. PLO Achieved Condition	Avg. PLO Achieved
				Pass	**2**		
				Fail %	**78%**	50%	No
				Pass %	**22%**		

Table 38: Average Achievement of PLO3

Student ID	Student Name	PLO3 Score Report					
		CLO2	PLO3 Score		Pass/Fail	PLO5 Grade	CQI
		Score Wieght 15%	Max. 15	100%			
Weight x Credit		15% x 3 = 0.45	0.45				
IDxxxA	Student A	2.94	2.94	20%	Fail	F	
IDxxxB	Student B	5.43	5.43	36%	Fail	F	
IDxxxC	Student C	7.35	7.35	49%	Fail	D	
IDxxxD	Student D	7.44	7.44	50%	Fail	D	
IDxxxE	Student E	9.69	9.69	65%	Pass	C	
IDxxxF	Student F	11.40	11.40	76%	Pass	B	
IDxxxG	Student G	6.63	6.63	44%	Fail	E	
IDxxxH	Student H	10.89	10.89	73%	Pass	B	
IDxxxI	Student I	12.12	12.12	81%	Pass	B+	
				Fail	**5**	Avg. PLO Achieved Condition	Avg. PLO Achieved
				Pass	**4**		
				Fail %	**56%**	50%	No
				Pass %	**44%**		

Table 39: Average Achievement of PLO8

Student ID	Student Name	PLO8 Score Report					
		CLO3	PLO8 Score		Pass/Fail	PLO5 Grade	CQI
		Score Wieght 25%	Max. 25	100%			
Weight x Credit		25% x 3 = 0.75	0.75				
IDxxxA	Student A	0.00	0.00	0%	Fail	F	
IDxxxB	Student B	9.80	9.80	39%	Fail	F	
IDxxxC	Student C	12.35	12.35	49%	Fail	D	
IDxxxD	Student D	14.55	14.55	58%	Pass	C	
IDxxxE	Student E	19.50	19.50	78%	Pass	B	
IDxxxF	Student F	17.50	17.50	70%	Pass	B	
IDxxxG	Student G	17.10	17.10	68%	Pass	C+	
IDxxxH	Student H	16.65	16.65	67%	Pass	C+	
IDxxxI	Student I	21.80	21.80	87%	Pass	A	
				Fail	**3**	Avg. PLO Achieved Condition	Avg. PLO Achieved
				Pass	**6**		
				Fail %	**33%**	50%	Yes
				Pass %	**67%**		

As pointed earlier, the pass/fail PLO threshold score and the average achievement of PLO can vary between HEIs. The condition of more than 50% depends on the requirement of the course and programme.

The calculations may appear laborious and could potentially discourage the instructors. Nevertheless, utilizing a spreadsheet like Excel can simplify the process. HEIs ought to focus on creating a mechanism that facilitates the automatic completion of all CLO and PLO attainment calculations and reporting. Instructors will only need to enter the assessment scores for each PLO. This system will empower the instructor, program coordinator, and department chair to continuously monitor the students' advancements and implement necessary improvements to boost their achievements.

8.3. Cumulative PLOs Attainment for Semester and Programme

Methods for assessing CLO and PLO achievement in courses have been outlined in the preceding sections. It is essential to carry out these assessments in order to gauge PLO achievement for the semester as well as the entire program.

8.3.1. Semester Report for PLOs Attainment

As stated in Section 8.2, the program head is required to provide a summary of the PLOs achievement for the semester. This summary is based on the data and reports provided by the instructors regarding the CLO and PLO attainment in their respective courses. Table 40 displays the PLOs achievement for Semester 1 Year 4 of the EA program, which consists of eight courses as outlined in the Course-PLOs mapping presented in Table 26 in Section 8.1.

The Credit Weight and PLOs achievement, extracted from the tables presented in the preceding sections, are consolidated by the programme head, as indicated in the green coloured row. This process is also carried out for the remaining seven courses taken by the students during that semester.

The average PLOs achievement of each PLOs can be calculated using the following formula

$$Avg.PLOx\ Achieve = \frac{CW_{course1} \times Ach.PLOx_{course1} + \cdots + CW_{course1} \times Ach.PLOx_{course8}}{Total\ CW_{PLOx}}$$

As an example, for PLO1:

$$Avg.PLO1\ Achieve = \frac{0.45 \times 79\% + \cdots + 0.3 \times 44\%}{4.25} = 82\%$$

Table 40: Semester 1 Year 4 PLOs Attainment of EA Programme

Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
			CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)
GEEI41ENG	English V	1	0.45	79%											0.75	68%	0.8	68%				
GEEI41FRE	French VII	1	0.45	95%											0.85	87%	0.45	87%				
GEEI41PEL	Power Electronics	3	1.50	89%	0.30	22%	0.45	44%									0.75	67%				
GEEI41REM	Research Methodology	2	0.5	69%					1.3	47%	1.2	94%			1.7	68%						
GEEI41MOD	Motor drive	3	0.6	81%	0.9	81%	1.5	79%									1.35	77%				
GEEI41MCS	Modern control systems	3	0.75	69%			2.25	58%											2.4	79%	1.5	79%
GEEI41INP	Industrial network protocol	2	0.4	86%			1.5	62%											1.3	58%	0.9	58%
GEEI41SPP	Student project part I	1	0.3	44%			0.75	57%	0.65	23%									0.55	62%	0.85	62%
CW Total			4.25		1.2		4.2		1.3		1.2		0		3.3		3.35		4.25		3.25	
Average PLO Achievement			82%		66%		64%		47%		94%		x		73%		74%		70%		69%	
PLOs Attained (>50%)			Yes		Yes		Yes		No		Yes		x		Yes		Yes		Yes		Yes	
CQI																						

*CW (Credit Weight) = Weight x Credit

From the average PLO achievement, attainment of PLOs for the programme level for the semester is determined using the threshold score used earlier. If the average PLOs achievement is greater or equal to 50%, then it is considered as 'achieved/attained', indicated by 'yes' and 'no' in the table above.

8.3.2. Annual Report for PLOs Attainment

The annual assessment for PLOs achievement combines the results from two semesters. Table 41 illustrates a sample PLOs achievement data for Year 4 of the EA program. HEIs have the discretion to determine if an annual PLOs achievement report is necessary in addition to the semester-based report.

Table 41: Annual PLOs Attainment of EA Programme

Semester	Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
				CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)
1	GEEI41ENG	English V	1	0.45	79%											0.75	68%	0.8	68%				
	GEEI41FRE	French VII	1	0.45	95%											0.85	87%	0.45	87%				
	GEEI41PEL	Power Electronics	3	1.50	89%	0.30	22%	0.45	44%									0.75	67%				
	GEEI41REM	Research Methodology	2	0.5	69%					1.3	47%	1.2	94%			1.7	68%						
	GEEI41MOD	Motor drive	3	0.6	81%	0.9	81%	1.5	79%									1.35	77%				
	GEEI41MCS	Modern control systems	3	0.75	69%			2.25	58%											2.4	79%	1.5	79%
	GEEI41INP	Industrial network protocol	2	0.4	86%			1.5	62%											1.3	58%	0.9	58%
	GEEI41SPP	Student project part I	1	0.3	44%			0.75	57%	0.65	23%									0.55	62%	0.85	62%
2	GEEI42SPP	Student project part II	1	0.2	81%			0.75	85%	0.75	85%	0.75	86%							0.55	78%	0.85	65%
	GEEI42SAA	Sensor and actuators	3	0.75	69%	2.25	48%															1.65	96%
	GEEI42PLC	Programmable logic controller	4	1.8	79%	3	59%	3	55%											2.2	96%		
	GEEI42ECD	Electronic circuit design	2	0.9	95%	1.5	89%	1.5	66%											0.5	86%		
	GEEI42DCD	Digital circuit design	2	0.4	86%	1.5	55%	1.5	98%											0.3	59%		
	GEEI42FRE	French VIII	1	0.25	69%											0.55	51%	0.85	51%				
	GEEI42ENG	English VI	1	0.25	87%											0.75	63%	0.25	88%				
CW Total				9.5		9.45		13.2		2.7		1.95		0		4.6		4.45		7.8		5.75	
Average PLO Achievement				80%		61%		67%		52%		91%		x		69%		70%		79%		76%	
PLOs Attained (>50%)				Yes		Yes		Yes		Yes		Yes		x		Yes		Yes		Yes		Yes	
CQI																							

*CW (Credit Weight) = Weight x Credit

8.3.3. End of Programme PLOs Attainment Report

The head of the programme is responsible for gathering the accomplishments of all PLOs from all courses across all semesters in order to create the end of programme PLOs attainment report. This report highlights the achievement of the PLOs for the entire programme and is considered crucial for Continuous Quality Improvement (CQI) purposes. An illustration of the end of program PLOs attainment for the EA program can be found in Table 42 displayed below.

Table 42: End of Programme PLOs Attainment (2020-2025)

Year	Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
				CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)
1	DTCI11KLC	Khmer Language for Communication	2	0.2	86%					1.68	84%							1.68	45%				
	DTCI11HAC	Humanity and Civilization	2	0.9	79%							1.12	85%			1.12	75%						
	DTCI11FRE	French I	2	0.9	95%					0.45	56%							1.12	85%				
	DTCI11GEO	Geometry	2	0.75	69%			1.5	85%													1.35	47%
	DTCI11MEC	Mechanics I	3	0.6	86%	2.25	83%	2.25	58%														
	DTCI11ENV	Environment	2	0.75	69%											1.68	95%	1.68	62%				
	DTCI12FRE	French II	2	0.9	79%					2.25	74%							1.12	64%				
	DTCI12CAL	Calculus I	3	1.35	95%			2.25	63%													0.9	65%
	DTCI12THE	Thermodynamic	3	0.6	81%			2.25	85%													0.9	98%
	DTCI12TED	Technical drawing	3	0.6	81%	2.25	58%	2.25	78%														
	DTCI12INF	Informatic	2	0.9	79%	1.5	62%													1.68	56%		
	DTCI12SAE	Business and Entrepreneurship	2	0.9	95%									1.1	59%	1.68	52%						
2	DTCI21FRE	French III	2	0.4	81%											1.68	36%	1.68	84%				
	DTCI21ENG	English I	2	0.4	81%											1.68	78%	1.68	91%				
	DTCI21MEC	Mechanics II	3	0.6	81%	2.25	89%	2.25	85%														
	DTCI21CAL	Calculus II	3	1.35	79%			2.25	66%													0.9	74%
	DTCI21CHE	Chemistry	3	1.35	95%	2.25	75%															1.35	65%
	DTCI21ELE	Electricity	3	0.6	81%	2.25	77%	2.25	78%														
	DTCI22FRE	French IV	2	0.4	81%											1.68	94%	1.68	62%				
	DTCI22CHE	English II	2	0.9	79%											0.56	69%	0.56	31%				
	DTCI22LIA	Linear algebra	3	1.35	95%			2.25	74%													0.9	58%
	DTCI22PRO	Probability	3	0.6	81%			2.25	65%													0.45	69%
	DTCI22VAW	Vibration and wave	3	0.6	81%			2.25	98%													0.65	87%
3	GEEI31COP	Computer Programming	1	0.45	85%	0.75	74%	0.75	81%											2.25	69%		
	GEEI31SAS	Signal and systems	2	0.9	56%	1.5	54%	1.5	56%											1.05	87%		
	GEEI31FRE	French V	1	1.50	56%																		
	GEEI31ENG	English III	1	0.25	78%																		
	GEEI31STA	Statistics	3	0.6	94%																	0.65	52%
	GEEI31ELC	Electrical circuit	3	0.75	56%	2.25	46%	2.25	78%														
	GEEI31ELA	Electronics analog	3	0.6	78%	2.25	85%	2.25	63%														
	GEEI32FRE	French VI	1	0.3	56%																		
	GEEI32ENG	English IV	1	0.2	58%																		
	GEEI32FCS	Feedback control systems	3	0.6	87%	2.25	45%	2.25	61%														
	GEEI32NMO	Numerical method and optimization	2	0.9	79%	1.5	65%	1.5	95%														
	GEEI32DIE	Digital Electronics	2	0.9	95%	1.5	87%	1.5	67%														
	GEEI32MIA	Microprocessor architecture	2	0.4	86%	1.5	69%	1.5	48%														
	GEEI32CIR	Communication and Inter. Relation	1	0.25	69%																		
	GEEI32ELM	Electrical machine	3	0.75	87%	2.25	58%	2.25	65%														
4	GEEI41ENG	English V	1	0.45	79%											0.75	68%	0.8	84%				
	GEEI41FRE	French VII	1	0.45	95%											0.85	87%	0.45	87%				
	GEEI41PEL	Power Electronics	3	1.50	89%	0.30	22%	0.45	44%									0.75	67%				
	GEEI41REM	Research Methodology	2	0.5	69%					1.3	47%	1.2	94%			1.7	68%						
	GEEI41MOD	Motor drive	3	0.6	81%	0.9	81%	1.5	79%									1.35	77%				
	GEEI41MCS	Modern control systems	3	0.75	55%			2.25	58%											2.4	79%	1.5	79%
	GEEI41INP	Industrial network protocol	2	0.4	78%			1.5	62%											1.3	58%	0.9	58%
	GEEI41SPP	Student project part I	1	0.3	44%			0.75	57%	0.65	23%									0.55	62%	0.85	62%
	GEEI42SPP	Student project part II	1	0.2	81%			0.75	85%	0.75	85%	0.75	86%							0.55	78%	0.85	65%
	GEEI42SAA	Sensor and actuators	3			2.25	48%															1.65	96%
	GEEI42PLC	Programmable logic controller	4	1.8	79%	3	59%	3	55%											2.2	96%		
	GEEI42ECD	Electronic circuit design	2	0.9	95%	1.5	89%	1.5	66%											0.5	86%		
	GEEI42DCD	Digital circuit design	2	0.4	86%	1.5	85%	1.5	98%											0.3	59%		
	GEEI42FRE	French VIII	1	0.25	69%											0.55	51%	0.85	51%				
	GEEI42ENG	English VI	1	0.25	87%											0.75	63%	0.25	61%				
5	GEEI51ENG	English for work	1	0.45	95%					0.75	74%					0.75	45%	0.25	58%				
	GEEI51MIP	Module d'insertion profesionnel	1	0.2	86%					0.75	65%					0.75	69%	0.25	95%				
	GEEI51PRM	Project management	2	0.5	87%	1.5	89%													0.3	69%	1.1	62%
	GEEI51SPP	Student project part III	1	0.2	86%			0.75	73%	0.75	56%	0.75	63%							0.15	84%	0.55	58%
	GEEI51EME	Embedded electronics	3	0.6	86%	2.25	89%	2.25	62%														
	GEEI51INA	Industrial automation	3	0.6	86%	2.25	85%	2.25	45%														
	GEEI51TEC	Technopreneurship	1	0.2	86%							0.75	47%	0.55	69%								
	GEEI51ELV	Extra-low voltage design	3			2.25	78%	2.25	87%														
	GEEI51WSP	Work-life and social psychology	1	0.2	86%							0.75	58%			0.75	85%						
	GEEI52FYI	Final Year Internship	12	2.4	86%	9	59%	9	56%	9	85%	9	98%	6.6	85%	9	68%	3	85%	1.8	62%	6.6	62%
CW Total				41.35		55.2		69.45		18.33		14.32		8.25		25.93		19.15		15.03		22.05	
Average PLO Achievement				85%		51%		68%		76%		89%		80%		69%		72%		73%		67%	
PLOs Attained (>50%)				Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
CQI																							
*CW (Credit Weight) = Weight x Credit																							

9. Digital Tools for Assessment

Digital tools are innovative ways utilised in online tests, knowledge checks, peer evaluations, quizzes, assignments, and examinations to measure student learning progress and achievement. These tools assist in assessing and evaluating student learning. In conducting formative assessment, instructors can use variety of digital tools, typically Web 2.0 tools and media to check understanding and concepts such as online quizzes, in-class questions, polls, survey or discussion. For summative assessment, conducted at the end of a course, tools such as online tests, exams, or e-portfolios can be optimised to measure students' knowledge, skills and competencies.

This section highlights how instructors can use digital tools to assess and provide feedback on students' performance. It provides some guides on how to use some of the tools and strategies that can help instructors to measure students' learning outcomes to improve their performance.

The digital assessment process can be performed by different individuals or groups (group work and peer review). It can provide different options to assess students beyond the traditional exam. Instructors plan their lessons and activities around learning outcomes and they need ways to check that students have achieved those goals. Using digital tools for assessment saves time, engages students and makes life a little easier. Assessment is more than just quizzes and tests. There are many tools available for instructors and students but that also depends on resources made available in the institutions.

Below are some common digital tools and online platforms for assessments used in Cambodian HEIs. However, there are many other digital tools and online platforms that instructors can use to measure their student learning. HEIs are encouraged to have their own learning management system (LMS) for teaching, learning and assessment.

(i) **Padlet**: It can be used in various methods, commonly used as: i. Discussion or brainstorming - the instructor poses a question and all students respond, ii. Class blog - for sharing research, feedback, or questions about an assignment, iii. Group portfolio - students post their work in progress for peer review and iv. Group exercise - teams are given different themes to research and record their findings on a Padlet, then share with the whole class in a face-to-face presentation. Figure 8 shows an example of the integration of Padlet in a 'English for Engineering' course. More importantly, the key benefits of Padlet are as follows:

   a. Highly visual and intuitive collaborative.
   b. Enhanced features in the Backpack licence (site licence).
   c. Users can collaborate in a variety of ways.
   d. Linked documents can be uploaded and viewed within Padlet.
   e. Different Padlet types: Wall, Canvas, Stream, Grid, Shelf, Backchannel.
   f. Padlet updates in real time.
   g. Flexible collaboration.

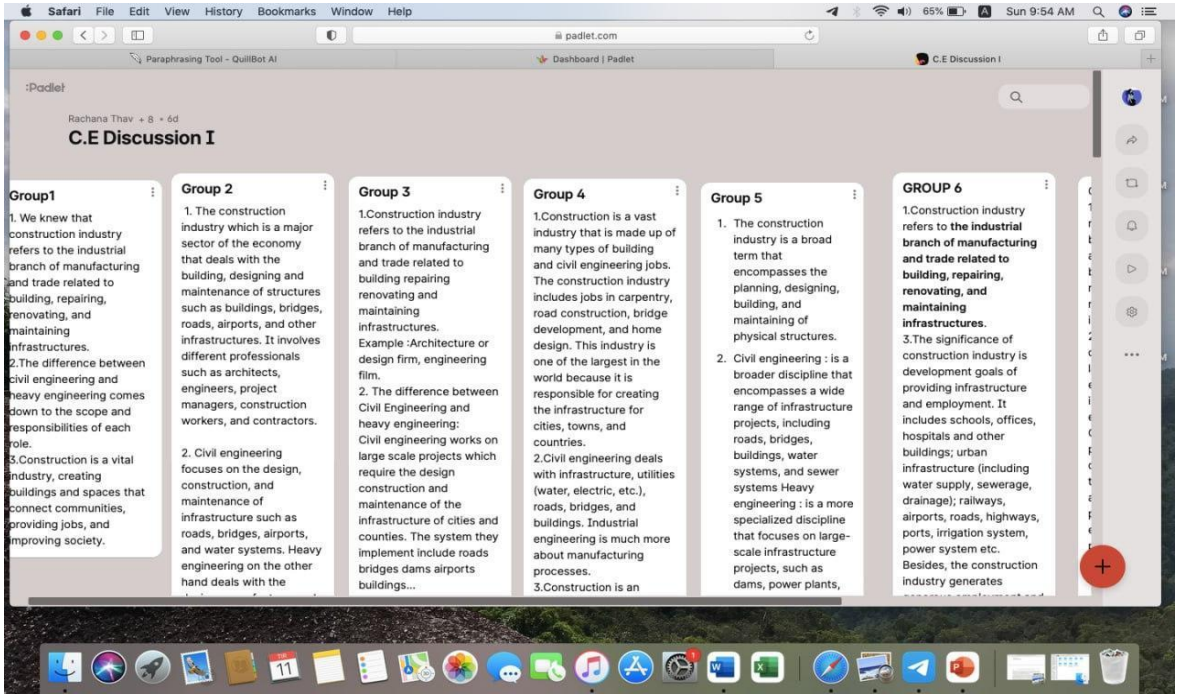

Figure 8: The Integration of Padlet in 'English for Engineering' Course

(ii) **Mentimeter**: It is used for quizzes and formative assessments to check students' understanding and review concepts. It is a presentation based digital tool that allows instructors to create an engaging and interactive environment for students in real time to take quizzes or polls via a mobile device, tablet and computer; and instructors can see the results immediately. Instructors can create a quiz or poll made up of multiple choice or open-ended questions for the whole class, group, or individual students. For example, if instructors want to ask an open-ended question, an ongoing post-board will appear on the screen and students can add responses to the question as they please (Figure 9).

Figure 9: The Integration of Mentimeter in the Classroom

(iii) **Quizizz:** It is a learning platform that offers multiple tools to make classroom fun, engaging, and interactive. Instructors can use Quizizz to create games and quizzes, host live activities, and assign tasks.

(iv) **Google Docs:** It is an online tool used in many different ways for formative assessment. Instructors can use Google Docs to assess students' understanding and provide feedback to students in many different ways, such as questions and answers at the end of a lesson or class period, collaborative writing, quizzes, tests, peer review, reflection and self-assessment. For example, for collaborative writing through the Google Docs, instructors can create a shared document for students to work together to write up, edit and submit assigned task electronically. Instructors can check and monitor the progress and offer feedback to students' writing.

(v) **Google Forms**: It is a free but versatile platform with multifaceted tool to create online questions of various types, including quizzes, surveys, multiple-choice questions, true or false questions using the templates provided. This Google App provides instructors with automated grading and response analysis. Instructors can view summary data, individual responses, or export data to Google Sheets for deeper analysis.

(vi) **Moodle**: It is an open-source learning management system (LMS). It is a learning platform to create and deliver online courses with different assessment tools including multiple-choice, true or false, quizzes, video presentation and essays. It can be used for complex assignments and assessments. Students can submit directly their written assignments as files into Moodle. Instructors can download all submitted work and upload all marked assignments with comments and feedback for each student.

(vii) **Microsoft Teams (MS Teams)**: It can be used for creating an assignment or assessment to grading and feedback. It allows students to work together on shared projects or group assignments. Instructors can use MS Teams as a formative and summative assessment tool. With MS Teams, instructors can create questions, quizzes, and assigned assignments; and provide instruction to students.

Online tools enhance and make the assessment process more efficient by providing instant feedback, engaging students, and offering comprehensive data for instructors to gain feedback on student learning and the effectiveness of the instruction. The choice of tools depends on the specific needs of the classroom, the type of assessment, and the availability of the technology.

10. Feedback of Student Assessment

Feedback of student assessment is feedback provided by instructors to students before and after the assessment, test or exam to help improve student's performance. Providing feedback means giving students an explanation of what they are doing correctly and incorrectly, with the focus on what the students are doing right. It is most productive to student's learning when they are provided with an explanation as to what is accurate and inaccurate about their work. One technique is to use the concept of a "feedback sandwich" to guide instructors' feedback, which is Compliment, Correct, Compliment.

Feedback provision allows students to acknowledge the quality of their tasks (the strengths and weaknesses of their work), to improve learning in new ways (think and reflect more critically to improve their work), and to develop their ability to evaluate and manage their own learning. Because of its essential role in teaching, learning and assessment, constructive feedback helps students to understand the progress of their learning, strengths and weaknesses and areas for improvement, programme manager shall require instructors to give effective feedback to students during and after an assessed assignments or tasks to ensure better performance. HEI's assessment policy shall state the timeframe for giving feedback.

10.1. Feedback strategies

Student assessment feedback can be given individually or collectively to a group or class, depending on learning outcomes, activities, tasks, and individual student needs. Instructors have various options for providing feedback, including oral, audio, video, written feedback, in-class, out-of-class, in meetings, email, rubrics, and more. Feedback can be given during a lesson or after returning an assignment that has been graded. Some common approaches for instructors to provide feedback are the following:

Written feedback or formal feedback: It is systematically scheduled and planned in the process of providing feedback. Instructors may use written feedback to provide comments on students' assignments, projects, and assessment tasks. Areas of strength and suggested comments for improvement are highlighted in written feedback. Either it is individual feedback or group feedback, instructors can meet with a few students per day or per week based on specific assessed tasks, due date and the needs of individual students or individual groups. Before the meeting with individual students or groups, instructors may need to prepare and do the following tasks:

- Read through students' work beforehand;
- Use a checklist or feedback form that students can use for making revisions;
- Provide clear comments and guidance on how to improve students' work; and
- Provide time to students to clarify or ask questions or provide inputs.

Oral feedback or informal feedback: Instructors may use oral feedback or informal feedback at any time to provide comments or feedback in person, in class, over the phone or through video conference. Instructors may use oral or informal feedback to provide immediate feedback, to answer questions, to guide or engage in discussion about the progress of a student.

10.2. Effective feedback on student assessment

According to Dinham (2002), there are four questions that an instructor should consider: i. what can the student do? ii. what can't the student do? iii. how does the student's work compare with that of others? iv. how can the student do better? Instructors should ponder on these questions when giving feedback to students.

Suggested comments are understandable and actionable: It is essential that feedback or suggested comments are clear and practical, enabling students to make necessary revisions to their work. The feedback provided should effectively communicate to students what is correct or incorrect, followed by explanations or examples.

Given in a timely manner: Feedback given to students needs to be given in a timely manner. When feedback is given immediately after showing proof of learning, the student responds positively and remembers the experience about what is being learned. If the instructor postpones the time to give feedback, the moment is lost and the student might not connect the feedback with the action. Instructors shall provide feedback as soon as possible after the tasks are given back to them, so that students have time to improve their tasks.

As stated in requirement 4.6 in Criterion 4 of AUN-QA "Feedback of student assessment is shown to be provided in a timely manner", hence HEIs shall set up clear timeframe in giving feedback after a test/exam or after marking assignments. For example, no later than 14 working days after returning students' assignment.

Methods of giving feedback: Feedback on tests or exams can be given in individual session or can be discussed in class if many students are facing difficulties with the same questions. Peers can also be involved in giving feedback related to tests or assignments. This will train students in giving objective feedbacks and constructive comments. The instructor must make a decision on the most effective method to enhance students' comprehension and to help them perform better in the upcoming assessments.

Motivation and recognition: Besides highlighting areas for improvement, feedback should also acknowledge areas where students have worked well individually or in groups. The recognition of students' work motivates them to continuously work hard for better improvement to achieve their goals.

11. Management of Assessment

The HEI's function as an entity that grants qualifications is closely tied to the credibility of its assessment system. Therefore, the HEI must establish and execute its own assessment procedures and protocols within its administrative framework.

The management of assessments in educational settings involves a comprehensive approach to ensure the quality of assessments. Assessments are not only conducted through traditional paper-based and online tests/exams but also include oral exams, practical work and tests, portfolio evaluations, projects, case studies, internship etc., each requiring different ways in ensuring the standards used in developing the assessment tasks, assessing the work, analysing the students' performance, reporting students' achievement and attainment of CLOs and PLOs as well as conducting CQI to ensure the enhancement of learning and the assessment tools.

This discussion will be divided into two main subsections: Policy and Security. Each subsection will outline specific practices and rules at various levels of an institution to maintain standards and safeguard for the assessment process.

11.1. Policy

Policies play a pivotal role in the management of assessments, providing the framework within which assessments must be conducted to ensure fairness and consistency. This subsection will focus on the rules and regulations set by higher education institutions, faculties or departments, course committees, and lecturers. These policies are designed to guarantee the quality of assessment by establishing clear standards and procedures at each level of the academic hierarchy.

11.1.1. Higher Education Institution

- Institutional Guidelines: These include comprehensive policies on the conduct of examinations, including the methods of assessment, use of technology, and procedures

for handling malpractices. Institutions often have a central body that oversees the implementation of these policies to maintain fairness and transparency.
- Quality Assurance: Institutions must have mechanisms for regular audits and reviews of the assessment processes to ensure compliance with national and international standards.

11.1.2. Faculty/Department

- Specific Policies: Faculties or departments may have additional specific rules tailored to their unique disciplinary needs. These can include the types of allowed materials during exams, specific grading criteria, and customised procedures for managing and reviewing assessments.
- Coordination with Institutional Policies: While maintaining their specific needs, departments must align their policies with those of the higher institution to ensure consistency across the board.

11.1.3. Course Committee:

- Assessment Strategies: The course committee is responsible for developing and approving the assessment strategies for each course, ensuring they are fair, equitable, and aligned with the learning outcomes.
- Feedback and Adjustments: They are also tasked with gathering feedback on assessments and making necessary adjustments to improve fairness and effectiveness.

11.1.4. Lecturers

- Implementation of Policies: Lecturers play a critical role in the direct implementation of the policies. They are responsible for ensuring that the assessments are conducted as per the guidelines and that all students are aware of the rules.
- Quality Control: Lecturers are often involved in setting exam papers and marking assessments, where they must adhere strictly to the criteria set forth by both the department and the course committee to maintain quality and fairness.

11.2. Security

The security of assessments is critical to ensuring that the integrity of the examination process is maintained. This involves the implementation of both physical and digital security measures tailored to the different formats of assessments, ranging from traditional paper-based tests to modern online exams. The focus here will be on outlining the specific security practices necessary for safeguarding both paper-based and online assessments against potential threats and vulnerabilities.

11.2.1. Paper-based Exams

- Physical Security: Educational institutions must ensure physical security measures are in place to prevent unauthorised access to exam materials. This includes secure storage facilities for exam papers and controlled access to these areas.
- Surveillance and Monitoring: The use of surveillance cameras in exam halls can deter misconduct and help monitor the examination environment. Additionally, the presence of invigilators or proctors is crucial to oversee the conduct of the exam.
- Sealing and Secure Distribution: Exam papers should be sealed and kept confidential until the time of the exam. The process of distribution should be meticulously planned to prevent any leaks or tampering with the documents.

11.2.2. Online-based Exams:

- Digital Security Measures: Institutions must employ advanced cybersecurity measures such as the use of secure servers, data encryption, and strong authentication protocols to protect the integrity of online exams.

- Monitoring Software: Utilising proctoring software can help in monitoring students during exams. These tools can track eye movement, keystrokes, and even flag suspicious behaviour by accessing webcams and microphones.
- Access Control: Limiting access to online exam platforms to only those students who are registered for the exam and during the designated exam times can prevent unauthorised access and potential breaches.

Apart from the roles and rules discussed above, few other responsibilities regarding assessment for the different entities are shown in Table 43. The roles and processes may vary between institutions.

Table 43: Responsibilities of Different Entities within the HEI Regarding Assessment

Entity	**Responsibilities**
HEIs/Academic Council/Academic Board	● Develop and review assessment policies/procedures which includes - Academic quality of exam papers. - Academic integrity (submitting own work, not plagiarising) - Security in storing exams. - Security during administration of exams. - Confidentiality and integrity of students' academic records. - Appeal policy. ● Approve students' grades.
Faculty	● Ensure security of storing assessment tasks, particularly exams. ● Oversees the implementation of policies regarding assessment.
Head of Department/Course Coordinator	● Check and endorse the Course Assessment Plan. ● Set up a vetting committee consisting of experts in the same field in the department to moderate exam papers and major assessment tasks. It is crucial to guarantee that the levels of questions for the assessment/exams meet the highest level to be attained in cognitive, affective and psychomotor domains. ● Conduct moderation of grades to ensure consistency. Eg. ensuring that exams are graded based on answer scheme, ensuring consistency in marks between different instructors who are marking the same test/evaluating projects, presentations etc.
Lecturers	● Plan assessment tasks in accordance with the endorsed Course Assessment Plan by the Head of Department/Course Coordinator, following the Principle of Constructive Alignment. These tasks are designed to align with the Course Learning Outcomes (CLOs). ● Develop tests and exams based on the specifications outlined in the Table of Test Specifications (ToS). ● Adhere to all principles of assessment, including validity, reliability, constructive alignment and fairness in developing assessment tasks/tests/exams. ● Require students to conduct similarity check using tools such as turnitin for major assessments eg. thesis, term paper. ● Make proctoring arrangements for online exams, ensuring a secure and controlled environment. ● Ensure strict invigilation is implemented for in-class assessments. ● Provide feedback to students to support their learning and growth and given in timely manner.

12. Continuous Quality Improvement

Continuous Quality Improvement (CQI) is an essential mechanism within academic programmes to enhance the quality of education. The first step is to develop the Programme Educational Objectives (PEOs) and Programme Learning Outcomes (PLOs) that align with the vision and mission of the programme. Then, the existing programme curriculum and syllabi have to be developed/reviewed and revised based on the PEOs and PLOs. For each course, the Course Learning Outcomes (CLOs) have to be defined and surveys have to be conducted regularly to evaluate the awareness and comprehension of OBE among the stakeholders.

The assessment methods have to be designed to measure the achievement of PLOs and PEOs, and the data collected have to be analysed and used for CQI purposes to address the problem of skill set mismatch between the industries and institutions. The CQI plan implementation concept at the institutional level is based on the Deming's Cycle PDCA Model (Deming, 1993), which provides a systematic, effective and continuous approach to quality improvement. Then the institutions will see the effective improvement of the programme as well as close linkage between the industries and institutions for the job market for the graduated students.

Figure 10 illustrates the quality improvement plan cycle. The CQI for PEOs review cycle should be conducted every three to five years, CQI for PLOs cycle should be conducted every year, while the CLOs review cycle should be done every semester. There are different data sources that should be gathered from different stakeholders for the quality improvement of PEOs, PLOs and CLOs. For example, data from external assessors should be used to improve PEOs. Data from graduated surveys, employer surveys and alumni should be used to improve PLOs. After the data gathering, it should be sent to the department for data analysis and interpretation. as well as to decide on what needs to be improved. For example, data surveys on CLO may show there are some improvements that need to be done for the course (course content, equipment for practice in laboratory, interpersonal skill etc.) then CQI will need to be conducted to improve the course. Once the department analyses the students' result, it is necessary to assess whether all the CLOs are addressed within the semester and to determine which ones have been achieved and which ones have not been achieved. Recommendations should be made to enhance the CLOs that have not been achieved.

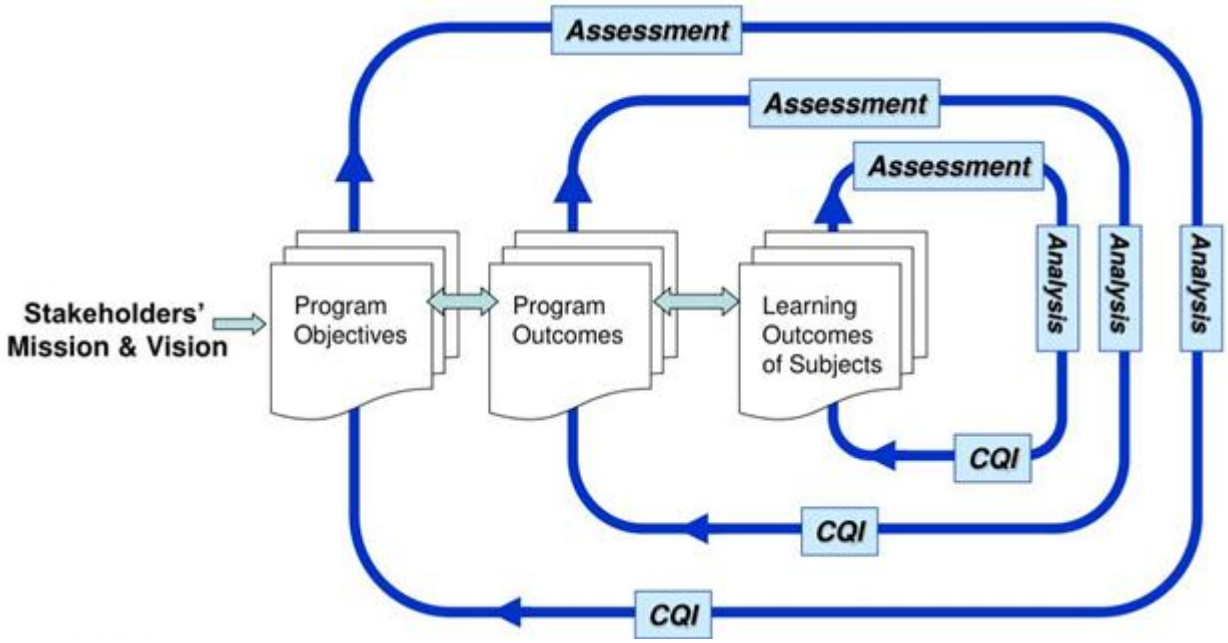

Figure 10: Quality Improvement Plan Cycle

Figure 11 illustrates about PDCA and key actions to be done at each stage. At 'Plan' stage, start with defining the problem or opportunity, analysing the situation, thinking creatively towards the best approach and developing an implementation plan. The 'Do' stage is focussed on implementing corrective actions and using data gathering tools to collect information. The 'Check' stage involves analysing information, monitoring trends and comparing obtained results; and stage of 'Action' involves making decisions based on the results obtained. If the results are as expected, then there is no need for CQI (maintain the same activities), but if the results are not as expected, repeat the PDCA and document the proofs and revise the plan.

Figure 11: PDCA Cycle

12.1. CQI for Course Learning Outcomes

CLOs are elements of technical or soft skills that each student must acquire prior to the completion of a specific course or subject taught. CLO is designed to support and be measurable against Programme Learning Outcomes (PLOs). CQI for course aims to improve the CLOs that have been outlined in the course syllabus. The CLOs have to be mapped with their respective summative assessment methods and CLO achievement should be shown in percentage. End-of-Chapter assessment is one of the summative assessment methods used to evaluate students' achievement at the end of a topic which will subsequently be awarded a grade. In case any CLO achievement is obtained at the low mean score/percentage, it means that the students are facing challenges in understanding the subject. Thus, implementation of CQI should be taken with the intention of improving achievement performance for each end of chapter.

The collection of the mean score of students' achievements at the end of course as a summative assessment is necessary in order to determine whether CQI is required. The respondents are the students who are involved in the course. If the mean score is less than the average, consider implementing CQI. Table 44 illustrates the interpretation of total mean score for CQI requirement. The CLO attainment is determined according to the score range. If the total score range of CLOs equal or more than 50%, it means that the CLOs is attained. In contrast, if the total score range of CLOs is less than 50%, it means that CLOs is not attained. However, the course instructor or programme coordinator might not only want their students to just pass the CLOs, they may want to produce highly capable students. Therefore, the CQI may involve increasing the benchmark for passing to 60% or 70%.

Table 44 provides a guide on whether CQI is required. The decision is based on students' mean score for the CLO. For instance, if the mean score is above 60%, CQI is necessary to

aim for students to reach excellence. The course instructor needs to maintain teaching activities and conduct regular monitoring of CLO attainment at the end of the course. If the total scores range from 50% to 60%, the course instructor should consider to implement CQI. If the total scores are less than 50%, CQI implementation is required. Detail of CLO assessment are in Section 8 of this guideline.

Table 44: A sample of Interpretation of Score Range for CQI Requirement

Score Range (%)	Status	Interpretation
>60%	Fairly Good	CQI is necessary to target that the performance is excellent
50%-60%	Fair	Consider to implement CQI
<50%	Poor	CQI is required

12.2. PDCA for Course Learning Outcomes

Data and results of formal assessment including results of the examination, test, lab report and project are collected for all courses. The analysis of the data is conducted to obtain the student achievement for each CLO and propose the action plan for the next semester through PDCA cycle.

In this section 'Power Electronics' course is used as an example for CQI implementation. This course consists of three CLOs and the course instructor has to assess all CLOs and decide for CQI implementation. Detail CLO assessment is in Section 8. In this guideline, CLO1 (CLO1: Ability to apply basic knowledge of power electronics components, power electronics structure, and its application in the EA and EE field.) of this course is used as example for CQI implementation. In the CLO assessment report (Table 45), the result illustrates that 89% students pass CLO; however, the course instructor also has to check the total score of each student as well as the achievement of each assessment method. The table below illustrates that the average total score of CLO1 is 72.9% and student A fail in CLO1 and few students fail in class test #1. Thus, the course instructor should consider to implement CQI.

Table 45: CLO1 Assessment for 'Power Electronics' Course

Student ID	Student Name	Mark Criteria								Total		CLO 1 Pass/Fail	CLO1 Grade	CQI
		Class Test #1		Class Test #2		Midterm		Final						
		CLO score (5%)	Pass/ Fail	CLO score (5%)	Pass/Fail	CLO score (20%)	Pass/ Fail	CLO score (20%)	Pass/ Fail	Score Max. 50	Score Max. in (%)			
IDxxxA	Student A	0.00	Fail	0.65	Fail	6.80	Fail	12.80	Pass	20.25	41%	Fail	E	
IDxxxB	Student B	2.80	Pass	2.85	Pass	10.80	Pass	17.40	Pass	33.85	68%	Pass	C+	
IDxxxC	Student C	2.30	Fail	4.30	Pass	13.00	Pass	17.80	Pass	37.40	75%	Pass	B	
IDxxxD	Student D	2.35	Fail	4.30	Pass	13.60	Pass	14.00	Pass	34.25	69%	Pass	C+	
IDxxxE	Student E	4.30	Pass	2.85	Pass	15.60	Pass	15.60	Pass	38.35	77%	Pass	B	
IDxxxF	Student F	4.45	Pass	2.80	Pass	19.40	Pass	17.80	Pass	44.45	89%	Pass	A	
IDxxxG	Student G	4.45	Pass	3.35	Pass	13.40	Pass	15.80	Pass	37.00	74%	Pass	B	
IDxxxH	Student H	3.90	Pass	3.90	Pass	17.80	Pass	15.60	Pass	41.20	82%	Pass	B+	
IDxxxI	Student I	4.85	Pass	3.40	Pass	19.60	Pass	13.40	Pass	41.25	83%	Pass	B+	
								Average score		36.44	# Fail	1	Avg. CLO Pass/Fail Condition	Avg. CLO Achievement
								Average score (%)		72.89	# Pass	8		
											Fail %	11%	50%	Pass
											Pass %	89%		

Table 46 shows about the PDCA on the CLO1. The course instructor and the department coordinator discuss about the corrective action plan, time frame for the implementation and check the trend.

Table 46: PDCA on CLO1 for CQI Implementation

PDCA	Implementation
Plan	- According to the score report, Student A fails for CLO1 attainment (20.25/50 or 41%). The program coordinator and course instructor have to identify the root cause of this problem. It can be because of inappropriate teaching and learning methods, using inappropriate assessment tools etc. Thus, CQI for the students should be conducted. - The program coordinator and course instructor should discuss and identify the best approach to solve the problem (e.g. using problem-based learning or inquiry-based learning or reduce complexity of the assessment. Furthermore, program coordinator has to regularly follow up the student learning activities and teaching method at the end of each chapter to ensure that the activities are on the right track to achieve CLO1. - The course instructor proposes to apply the new teaching method and assessment in the next semester.
Do	- The same course instructor applies the new or corrective teaching method and assessment tool in the next semester - The program coordinator collect data on CLO1 attainment from the new students who take the same course from the same course instructor
Check	- The program coordinator analyses the data and checks the trends before making modification of teaching and learning method and assessment tool.
Act	- If the results indicate that the students pass CLO1, then the teaching methodology and assessment can be maintained. However, if the results are not as expected, repeat the PDCA and document the proofs and revise the plan.

While evaluating and implementing CQI for underperforming CLOs, the instructor must also monitor the overall course learning outcomes. According to Table 47, 89% of students pass CLOs in the Power Electronics Course, with an average CLO attainment of 65.54%. Therefore, it is crucial to focus on achieving excellent performance through CQI. Additionally, the instructor and program coordinator need to identify the root cause, particularly in CLO2 and CLO3, and suggest the most effective solution (such as revising teaching methods or assessment techniques) for the upcoming semester. Subsequently, they should analyse the trends before and after implementing corrective measures. If the CLO attainment meets expectations, the activities should be maintained; otherwise, the PDCA cycle should be repeated.

Table 47: CLO Total Marks Assessment (Power Electronics Course)

Student ID	Student Name	Assessment - Power Electronics			Toal		Subject Pass/Fail	Course Grade	CQI
		CLO1 (50%)	CLO2 (25%)	CLO3 (25%)	Score Max. 25	Score Max. in (%)			
IDxxxA	Student A	20.25	4.90	0.00	25.15	25%	Fail	F	
IDxxxB	Student B	33.85	9.05	9.80	52.70	53%	Pass	C	
IDxxxC	Student C	37.40	13.85	12.35	63.60	64%	Pass	C	
IDxxxD	Student D	34.25	14.90	14.55	63.70	64%	Pass	C	
IDxxxE	Student E	38.35	17.95	19.50	75.80	76%	Pass	B	
IDxxxF	Student F	44.45	19.00	17.50	80.95	81%	Pass	B+	
IDxxxG	Student G	37.00	14.65	17.10	68.75	69%	Pass	C+	
IDxxxH	Student H	41.20	18.15	16.65	76.00	76%	Pass	B	
IDxxxI	Student I	41.25	20.20	21.80	83.25	83%	Pass	B+	
Average CLO score		36.44	14.74	14.36	0.655	Fail #	1		
Average CLO score (%)		72.89	58.96	57.44	65.54	Pass #	8		
						Fail %	11%		
						Pass %	89%		

12.3. CQI for Programme Learning Outcomes

To enhance the quality of the programmes and meet the expectations of the students, it is essential to have a clear and consistent method for continuous improvement. Programme assessment is a process that involves measuring outcomes regularly and using the results to make improvements in the programmes. The plan-do-check-act cycle is a useful framework for designing assessment plans that suit the needs of the programme, gathering and analysing the data, and applying the results to improve the programme.

The desired outcomes are determined first and the curriculum, teaching and learning methodology, human resources, and supporting facilities are designed to support the intended outcomes. The students' achievements of the outcomes are measured during the course of the study and after the students have graduated and worked in industry. Assessment methods have to be formulated to measure the attainment of PLO, from which data are collected, analysed and further used in the CQI process. The changes made in the curriculum are to reflect the needs of the stakeholders (students, alumni and employers) and industry demands for competent students.

Apart from conducting the PLO attainment based on the CLOs attainment, there are several other sources that can be used to collect information to determine PLO attainment.

- Industrial Survey: As part of the curriculum, the students have to complete a 12-week industrial training in their final semester of the third year. The employer's feedback on the students' performance is collected through a survey every year. The survey evaluates how well the students meet the attributes that are relevant to the PLO.
- Alumni Panel: The Alumni Panel is composed of graduates from the departments. They have a good understanding of how the programme prepared them for their current jobs, and they can identify the gaps in the programme content and suggest to the department on the latest industry demands. The feedback from the Alumni Panel is crucial for keeping the programme content relevant and aligned with the job market's needs
- Student Self-Survey: The students are required to complete a self-assessment on how well they have achieved the CLO at different points in the semester. This can help the lecturer evaluate how effective their teaching methods are for

a specific course. Furthermore, the students also have to give feedback on the lecturers' overall performance in areas such as communication skills, confidence level and appearance at the end of each course. These results are used for CQI purposes to improve the lecturers' delivery skills and the course syllabus.

- Annual surveys: Annual survey from students are crucial for educational institutions to gather valuable feedback on various aspects of the learning environment and teaching effectiveness. They serve as a reliable source of data to inform decision-making, improve pedagogical strategies, and enhance student engagement and satisfaction. By regularly soliciting student input, the HEIs can identify strengths and areas for improvement, ensuring that the educational experience is aligned with student needs and expectations. Furthermore, these surveys can help in setting strategic goals, supporting faculty development, and fostering a positive academic climate, ultimately contributing to better educational outcomes. The faculty can design the platform for the survey in google forms and ask the students to complete.

12.4. PDCA for Programme Learning Outcomes

In this guideline, PLO attainment information is gathered from the students and is used in making decision for CQI implementation. As in Section 7, 'Assessment of Programme Learning Outcomes', EA programme is used as an example. The assessment of PLO starts with PLOs in course attainment, semester PLOs attainment, annual PLOs attainment and end of programme PLOs attainment.

The 'Power Electronics' course is mapped to PLO1, PLO3, and PLO5. Table 48 illustrates that Student A fails in PLO1, which is mapped to CLO1 and CLO2. The problems might arise from the course instructor who may not have used the appropriate strategy for teaching or inappropriate assessment methods selected or weighting of each assessment was wrongly set or inappropriate student learning time spent for each CLO. It could be for a multiple of reasons. Hence, it is important to identify the root cause in planning for CQI.

Table 48: Achievement of PLO1

Student ID	Student Name	PLO1 Score Report						
		CLO1	CLO2	PLO1 Total		Pass/Fail (50%)	PLO1 Grade	CQI
		Score Wieght 50%	Score Wieght 10%	Score Max. 60	Score Max. in (%)			
Weight x Credit		50% x 3 = 1.5	10% x 3 = 0.3	1.8				
IDxxxA	Student A	20.25	1.96	22.21	37%	Fail	F	
IDxxxB	Student B	33.85	3.62	37.47	62%	Pass	C	
IDxxxC	Student C	37.40	5.54	42.94	72%	Pass	B	
IDxxxD	Student D	34.25	5.96	40.21	67%	Pass	C+	
IDxxxE	Student E	38.35	7.18	45.53	76%	Pass	B	
IDxxxF	Student F	44.45	7.60	52.05	87%	Pass	A	
IDxxxG	Student G	37.00	5.86	42.86	71%	Pass	B	
IDxxxH	Student H	41.20	7.26	48.46	81%	Pass	B+	
IDxxxI	Student I	41.25	8.08	49.33	82%	Pass	B+	
Average score		36.44	5.90	0.706	Fail	1	Avg. PLO Achieved Condition	Avg. PLO Achieved
Average score (%)		72.89	58.96	70.57	Pass	8		
					Fail %	11%	50%	Yes
					Pass %	89%		

At the same time, although 89% students passed the PLO1, the course instructor and programme coordinator should prepare the activity in PDCA to improve for any PLOs which were not attained. They need to regularly monitor the activities to ensure that the performance is excellent.

Table 49 shows that PLO4 was not attained for the semester attainment. Therefore, the program coordinator has to identify which courses had contributed to PLO4 then check the CLOs that was mapped to this PLO4. PDCA is used to design the activities, propose the best approaches and check the trends before and after implementing the revised action. If the results show that the student passes PLO4, then maintain the activities (e.g. teaching methodology and assessment). However, if the results are not as expected, repeat the PDCA. Document the proofs and revise the plan.

Table 49: Semester 1 Year 4 PLOs Attainment

Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
			CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achiev e (%)	CW*	Achiev e (%)	CW*	Achiev e (%)	CW*	Achiev e (%)	CW*	Achiev e (%)	CW*	Achiev e (%)	CW*	Achiev e (%)
EE400	Electric Drive	1			0.45	79%	0.6	90%	0.8	45%												
EE400	Modern Control System	3			0.75	95%	2.7	80%	1.95	68%												
EE400	Power Electronics	3	1.80	89%			0.75	78%			0.45	67%										
EE400	Research Methodology	3	0.8	69%									1.35	85%	2.55	68%						
EE400	Industrial Network Protocol	3			0.9	81%	1.5	79%	1.05	21%												
EE400	Student Project Part 2	3	1.2	69%	0.45	69%	2.25	58%	1.65	32%	1.8	94%	1.35	89%	1.05	80%						
CW Total			3.75		2.55		7.8		5.45		2.25		2.7		3.6		0		0		0	
Average PLO Achievement			79%		83%		74%		45%		89%		87%		72%		x		x		x	
PLOs Attained (>50%)			Yes		Yes		Yes		No		Yes		Yes		Yes		x		x		x	
CQI																						
*CW (Credit Weight) = Weight x Credit																						

Table 50 shows the annual PLOs attainment. All PLOs are attained; however, the average PLO achievement of PLO4 and PLO10 is still low compared to other PLOs. The program coordinator has to check how many courses contribute to PLO4 and PLO10, then take actions to improve students' performance in those courses.

Table 50: Year 4 Annual PLOs Attainment

Semester	Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
				CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)	CW*	Achieve (%)
1	EE4001	Electric Drive	1			0.45	79%	0.6	90%	0.8	45%												
	EE4002	Modern Control System	3			0.75	95%	2.7	80%	1.95	68%												
	EE4003	Power Electronics	3	1.80	89%			0.75	78%			0.45	67%										
	EE4004	Research Methodology	3	0.75	69%									1.35	85%	2.55	68%						
	EE4005	Industrial Network Protocol	3			0.9	81%	1.5	79%	1.05	21%												
	EE4006	Student Project Part 2	3	1.2	69%	0.45	69%	2.25	58%	1.65	32%	1.8	94%	1.35	89%	1.05	80%						
2	EE4007	Sensors and Actuators	3					2.25	67%	1.65	56%	1.8	75%									2.4	68%
	EE4008	Programmable Logic Controller	3					2.25	68%	1.65	88%	1.8	57%										
	EE4009	Real-Time Embedded Systems	3					2.25	87%	1.65	68%	1.8	97%							2.4	97%		
	EE4010	Electronics Circuit Design and Manufacturing	3					2.25	76%	1.65	76%	1.8	75%										
	EE4011	International languages for work	3											1.35	97%		85%	2.4	57%				
	EE4012	Student Project Part 3	4			0.6	57%	3.8	57%	2.2	87%	2.4	57%	1.8	85%		85%	3.2	85%				
CW Total				3.75		3.15		20.6		14.25		11.85		5.85		3.6		5.6		2.4		2.4	
Average PLO Achievement				79%		78%		71%		64%		75%		89%		72%		73%		97%		68%	
PLOs Attained (>50%)				Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
CQI																							

The process is the same for end of programme PLOs attainment. Table 51 shows the end of programme PLOs attainment. The programme coordinator checks whether there are any PLOs which were not attained. It is still necessary to conduct CQI in order to maintain the good performance if the PLOs are attained. PDCA is repeated in cases that the PLOs are not attained.

Table 51: End of Programme PLOs Attainment

Year	Course ID	Course Name	Credit	PLO1		PLO2		PLO3		PLO4		PLO5		PLO6		PLO7		PLO8		PLO9		PLO10	
				CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve	CW*	Achieve (%)
1	EE10	Effective Communication Skills	1									0.6	86%	0.45	68%	0.85	86%						
	EE10	Engineering Mathematic I	3	0.8	76%	1.35	85%											2.4	96%				
	EE10	Programming C++	3	0.8	67%			1.8	57%													2.4	36%
	EE10	Physic for Engineering I	3	0.8	57%	1.35	67%													2.4	35%		
	EE10	Engineering Mathematic II	3	0.8	85%	1.35	44%											2.4	68%				
	EE10	Chemistry for Engineering	3	0.8	56%																	2.4	63%
	EE10	Physic for Engineering II	3	0.8	67%	1.35	46%													2.4	73%		
	EE10	Basic Writing and Research Skills	3									1.8	86%	1.35	57%	2.55	85%						
2	EE20	Calculus for Engineers	3	0.8	56%	1.35	37%																
	EE20	Engineering Mechanics	3					1.8	85%	2.4	35%									2.4	96%		
	EE20	Fundamentals of Programming	3	0.8	75%			1.8	73%									2.4	45%				
	EE20	Electrical Systems	4			1.8	85%	2.4	90%	3.2	56%												
	EE20	Engineering Fundamentals: Principles, Resources, Processes and Materials	1					0.6	96%														
	EE20		3					1.8	96%					1.35	76%							2.4	56%
	EE20	Environmental Engineering	3											1.35	78%	2.55	68%						
	EE20	Engineering Drawing and Computer Aided	3					1.8	68%									2.4	46%				
3	EE30	Computer Programming	3	0.8	64%			1.8	96%													2.4	52%
	EE30	Signals and System	3					1.8	78%	2.4	74%											2.4	53%
	EE30	Electrical Circuit	3					1.8	75%	2.4	75%							2.4	64%				
	EE30	Electronic Analog and Filter	3					1.8	57%	2.4	84%									2.4	43%		
	EE30	Engineering Innovation and Ethics	3			1.35	86%					1.8	46%	1.35	64%	2.55	74%						
	EE30	Feedback Control System	3																				
	EE30	Digital Electronic and Microprocessor	3			1.35	64%			2.4	64%							2.4	75%	2.4	76%		
	EE30	Electrical Machine	4	1	77%					3.2	74%												
	EE30	Student Project Part 1	3	0.8	57%	1.35	57%	1.8	57%	2.4	57%	1.8	57%	1.35	45%	2.55	65%						
	EE30	Communication and Interpersonal Relation	1										42%	0.45	53%	0.85	53%						
	EE30	Numerical Method and Optimization	1			0.45	57%	0.6	57%							0.85				0.6	63%		
4	EE40	Electric Drive	1			0.45	79%	0.6	90%	0.8	45%												
	EE40	Modern Control System	3			0.75	35%	2.7	80%	1.35	68%												
	EE40	Power Electronic	3	1.80	83%			0.75	78%			0.45	67%										
	EE40	Research Methodology	3	0.8	69%										85%	2.55	68%						
	EE40	Industrial Network Protocol	3			0.3	81%	1.5	79%	1.05	21%												
	EE40	Student Project Part 2	3	1.2	69%	0.45	69%	2.25	58%	1.65	32%	1.8	94%		89%	1.05	80%						
	EE40	Sensors and Actuators	3					2.25	67%	1.65	56%	1.8	75%									2.4	68%
	EE40	Programmable Logic Controller	3					2.25	68%	1.65	88%	1.8	57%										
	EE40	Real-Time Embedded Systems	3					2.25	87%	1.65	68%	1.8	97%							2.4	97%		
	EE40	Electronic Circuit Design and	3					2.25	76%	1.65	76%	1.8	75%										
	EE40	International Language for work	3											1.35	97%	1.05	85%	2.4	57%				
	EE40	Student Project Part 3	4			0.6	57%	3.8	57%	2.2	87%	2.4	57%	1.8	85%	1.4	85%	3.2	85%				
5	EE50	Industrial Automation	1			0.15	58%	0.35	78%	0.55	58%												
	EE50	Environmental and Process Work	3											1.35	83%	1.05	85%					2.4	84%
	EE50	Image Processing	3			0.45	25%	2.85	53%	1.65	73%												
	EE50	Micro Computer	3			0.45	63%	2.85	74%	1.65	73%												
	EE50	Project Development and	3									1.8	73%	1.35	36%	1.05	75%			2.4	84%		
	EE50	Student Project Part 4	3	1.2	78%	0.45	74%	2.85	63%	1.65	57%	1.8	64%	1.35	76%	1.05	37%	2.4	75%	2.4	63%	2.4	85%
	EE50	Final Year Thesis	3	1.2	74%	0.45	35%	2.85	75%	1.65	47%	1.8	85%	1.35	84%	1.05	74%	2.4	64%	2.4	74%	2.4	53%
CW Total				14.65		18.15		54.55		42.2		23.25		16.2		23		24.8		22.4		21.6	
Average PLO Achievement				72%		65%		72%		64%		72%		71%		70%		68%		71%		61%	
PLOs Attained (>50%)				Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
CQI																							

12.5. CQI for Programme Educational Outcomes

The PEO are the skills or competencies that the graduates are expected to have acquired after three to five years in the workforce. The guide in assessing PEO attainment is provided in the GTCD. HEIs should regularly evaluate, update and refine their academic programmes to ensure and enhance the quality by following the CQI stages of 'plan', 'implement', 'monitor and review', and 'improve'.

CQI for PEOs is discussed in the GTCD. In this section, we will focus on some tools used to gather information to measure PEOs attainment. Among the input that can be gathered are from external assessors, alumni surveys and employer survey.

1. External assessor: The external assessor can be someone in the same field but from a different institution in Cambodia or from overseas. The role of the external assessor is to look into the programme, the attainment of the outcomes, course conduct, assessment and implementation. All programmes should be assessed by the external assessor to ensure that the programmes offered remain relevant. The comments from the external assessors will be considered for CQI implementation.
2. Employer survey: The employers whom the students are working with are responsible to provide feedback on the PEO and PLO statements, the structure of the programme, the course contents, the importance of skills, the exit survey and any other related matters such as the quality of programmes that are currently or used to be employed in their company/industry.
3. Alumni survey: All alumni graduated in the last five years are invited to respond to the survey. The aim of the survey is to track the career development of the graduates since they left the university. The survey is designed to be brief, clear and easy to complete, in order to increase the participation rate. Alumni who agree to take part are provided with a web link to access the survey, which is only available for a limited period of time.

Table 52 illustrates the alumni survey form for the Engineering Programme. The alumni survey can be used to improve PEO. The form can be given to the students of the Engineering Programme and ask them to rate the level of attainment of each PEO by placing a check on the corresponding column. Through the data gathering, analysing and reporting, the faculty/university will have enough evidence to decide whether there is a need for CQI. If the result of the survey shows that most alumni rate any PEOs as neutral or dissatisfied or very dissatisfied, CQI must be proposed and conducted to address the problem. In contrast, if most alumni rate any PEOs as satisfied or very satisfied, it can be seen that most of them agree with the PEO and no CQI implementation is required.

Table 52: Example of Alumni Survey Form for Engineering Programme

Alumni Survey Questionnaire	Very Satisfied (5)	Satisfied (4)	Neutral (3)	Dissatisfied (2)	Very Dissatisfied (1)
PEO1: The programme has equipped me to identify, analyse and design to solve today's complex engineering challenges while creating a sustainable environment.					
PEO2: The programme helps me meet industry expectations; possess excellent communication skills for both local and international markets and are consistently committed to life-long learning.					
PEO3: The engineering programme prepared me to act professionally with integrity and ethical uprightness; diligent, resourceful, and to be steadfast leaders of the society.					
PEO4: The programme instils in me genuine care for the environment; compassion for others, willingness to serve the socially challenged inspired by the spirit of St. Vincent de Paul, and be catalysts for social transformation.					

Source: Alumni survey (2013-2014), College of Engineering, Adamson University

Table 53 shows the employer survey form. The programme designs the form and ask the manager/supervisor of the company which the graduate is being employed to complete the form. The employer rates each question based on a scale range from very satisfied to dissatisfied. The data from the survey will be entered, analysed and used for report preparation. If the employer rates with dissatisfaction in any areas, the programme looks for the reason and proposes for the CQI in order to meet the employer satisfaction.

Table 53: Example of the Employer Survey Form

Company Name: _____
Person Completing Form: _____
Address: _____
Graduate/ Employee Name: _____
Graduate/ Employee Title: _____
Date of Hire: _____
Is the Graduate still employed by your company? Yes: O No: O
Please check the box which best indicates your level of satisfaction demonstrated by your employee's performance for each of the following:

Area	Very Satisfied	Satisfied	Dissatisfied
Overall job performance	O	O	O
Job specific skills	O	O	O
Problem solving skills	O	O	O
Individual and teamwork skills	O	O	O
Leadership skills	O	O	O

Would you consider having graduates in the future? Yes: O No: O
Based on your experience, how can improve the graduate's skills to meet your company's needs.

Detailed suggestions and feedback from stakeholders are discussed by the faculty and the programme. If there is a need to revise any section, CQI implementation based on the PDCA approach is necessary. Table 54 illustrates the feedback from the stakeholder including external assessor, industry and alumni students. The feedback and suggestions from the stakeholders can be obtained from the survey or meeting. Then the faculty and the programme respond to each feedback and decide whether it is necessary to propose for the CQI implementation.

Table 54: Feedback from the Stakeholder (external assessor, industry and alumni student)

Category	Issue	Raise by	Response
PEO/PLO	PEO statement is not clear Too many PLOs	External assessor Industry	PEO, PLO adjustment
Curriculum	Most of the courses are outdated Students' workload per semester is too much, subjects with redundant contents with other subjects should be merged and total credit should be increased	External assessor Industry	CQI for course outcome
Assessment	Lecturers are proposed to give feedback on marks/comments on quizzes/projects so that students are aware of their deficiency.	Student	
Teaching and learning	Students to have professional presentation skills with attractive presentation using Power Point	Industry	
Facility	Many computers are not functioning in Faculty Mini Lab.	Student	

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Appendices

Appendix A: Example of Detailed Course Syllabus (Course: Power Electronics, Year 4, Semester 1)

Week	Hours L/T/P	CLOs	Lesson Learning Outcomes (LLOs)	Topic	Teaching Method/Activity	Learning Method/Activity	Assessment Techniques	T&L Resources
1	2/2/2	CLO1	Ability to distinguish different PE devices, Ability to select semiconductor devices for specific specifications of the converter. Ability to select power electronics systems for suitable applications.	Introduction to Power Electronics System: Devices, Structure, and Application	Lecture on the passive device: the relationship between voltage and current (definition) Lecture on the active device: switch ON/OFF Lecture on conversion types of power electronics systems Lecture on the example of power converter for suitable applications: challenges, and issues Demonstrate how to perform Lab. #1: ON/OFF Diode/ MOSFETs	Review provided learning materials Review state-of-art of semiconductor devices Work as a group of two students on provided topics/resources and research on the internet about active devices. Presentation during Tutorial class Work as a group for Lab. Review Lab. topic before class.	--	PPT Completed document on active devices Lab. #1: Topic Safety guidelines for Lab. Class
2-3	4/4/4	CLO1 CLO2 CLO3	Ability to compute the half-wave rectifier with Diode and with Thyristor	Lecture 2: Operation and Device Sizing	Lecture on a single-phase half-wave rectifier with R load, RL load,	Review provided learning materials before	Progressive report and presentation according to	PPT Completed document of

			Ability to analyse the half-wave rectifier operation for different load types. Ability to simulate the half-wave rectifier with a case study. Ability to build a single-phase half-wave rectifier with 1 diode.	for Half-Wave Rectifier	RL+Vdc (DC motor) Demonstrate how to use Matlab/Simulink for a case study rectifier Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation: 1 case study Show the format of the report and the deadline to submit the report. Monitor and follow up on Lab. #1 Demonstrate how to perform Lab. #2: Half-wave rectifier for 10W Lecture on using KidCad for PCB design of 10W half-wave rectifier	class (Flip-Classroom) Review on state-of-art of half-wave rectifier system and its various range of applications Review how to use software (Matlab/Simulink, Spice) in the rectifier system. Working as a group of two students on provided topics for the selected names. Teach or instruct others in the class on the group findings (***only for assigned students***) Submit a synthesis report of the case study. Review Lab. #2 before class	lecture: ***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides: intro device model conclusion, 3 minutes presentation. Lab & assignment: hardware and report	Half-wave rectifier Lab. #2
4-5	4/4/4	CLO1 CLO2 CLO3	Ability to compute the full-wave rectifier with Diodes/Thyristor Ability to analyse the full-wave rectifier operation.	Lecture 3: Operation and device sizing for Full-Wave Rectifier	Lecture on a single-phase full-wave rectifier with R load, RL load, RL+Vdc (DC motor)	Review provided learning materials Review how to use software	Progressive report and presentation according to lecture: ***Rubrics***	PPT Completed document of full-wave rectifier Lab. #3

			Ability to simulate the full-wave rectifier with a case study. Ability to build a 1-phase full-wave rectifier		Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation for 1 case study Recall the format of the report and the deadline to submit the report. Monitor and follow up on Lab. #2 Demonstrate how to perform Lab. #3: Full-wave rectifier for 10W	(Simulink, Spice) in the rectifier system. Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on the group findings (***only for assigned students***) Submit a report of the case study. Continuous working on Lab. #2 Review Lab. #3 before class	(devices, construct PE, Modeling PE, prototype, Report) 5 slides & 3 minutes presentation. Lab & assignment: hardware and report	
6	2/2/2	CLO1 CLO2 CLO3	Ability to compute the 3-phase rectifier with 6 Diodes/Thyristor. Ability to analyse the 3-phase rectifier operation for different load types. Ability to simulate the 3-phase rectifier with a case study. Ability to build a 3-phase rectifier.	Lecture 4: 3-Operation and device sizing for 3-phase rectifier	Lecture on a 3-phase rectifier with R load, RL load, RL+Vdc (DC motor) Provide 12-15 problems (case study) Assign a pair of students as a group responsible for the oral presentation of only 1 case study	Review how to use software (Matlab/Simulink, Spice) in the rectifier system. Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on	Progressive report and presentation according to lecture: ***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides & 3 minutes	PPT Completed document of full-wave rectifier Lab. #3 Quiz #1

					during Tutorial class Recall the format of the report and the deadline to submit the report. Monitor and follow up on Lab. #3 Prepare problems (Quiz #1)	the group findings (***only for assigned students***) Submit a synthesis report of the case study. Continuous working on Lab. #3	Lab & assignment: hardware and report Class Test #1 (Quiz1)	
7	2	CLO1					Mid-term exam	Midterm doc.
8-9	4/4/4	CLO1 CLO2 CLO3	Ability to compute the Buck / Boost Converter Ability to analyse the Buck and Boost Converter operation. Ability to simulate the Buck Converter and Boost Converter with a case study. Ability to build Buck or Boost Converter.	Lecture 5: Operation and Device Sizing for DC-DC Non-isolated Converter Part 1	Lecture on a Buck Converter and a Boost Converter Demonstrate how to use Matlab/Simulink for a case study Buck/Boost converter. Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation for 1 case study Recall the format of the report and the deadline to submit the report. Demonstrate how to perform Lab. #4: Buck	Review how to use software (Matlab/Simulink) in the converter system. Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on the group findings (***only for assigned students***) Submit a synthesis report of the case study.	Progressive report and presentation according to lecture: ***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides & 3 minutes presentation. Lab & assignment: hardware and report	PPT Completed document of full-wave rectifier Lab. #4

					Converter and Boost Converter for 25W	Review Lab. #4 before class		
11-12	4/4/4	CLO1 CLO2 CLO3	Ability to compute the Buck-Boost Converter, Cuk and SEPIC Con. Ability to analyse the Buck-Boost, Cuk, and SEPIC operations. Ability to simulate the Buck-Boost/Cuk/SEPIC Converter with a case study. Ability to build Buck-Boost.	Lecture 6: Operation and Device Sizing for DC-DC Non-isolated Converter Part 2	Lecture on a Buck-Boost Converter, Cuk Converter, and SEPIC Converter Demonstrate how to use Matlab/Simulink for a case study Buck-Boost/Cuk/SEPIC converter Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation for 1 case study Recall the format of the report and the deadline to submit the report. Demonstrate how to perform Lab. #5: Flyback Converter for 25 W	Review how to use software (Matlab/Simulink, Spice) in the rectifier system. Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on the group findings (***only for assigned students***) Submit a synthesis report of the case study. Review Lab. #5 before class	Progressive report and presentation according to lecture: ***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides & 3 minutes presentation. Lab & assignment: hardware and report Class Test #2 (Quiz2)	PPT Completed document of full-wave rectifier Lab. #5 Quiz #2
13-14	4/4/4	CLO1 CLO2 CLO3	Ability to compute the Flyback Converter, Forward Converter	Lecture 7: DC-Power Supply Part 1	Lecture on a Flyback and Forward Converter	Review how to use software (Matlab/Simulink, Spice) in the rectifier system.	Progressive report and presentation according to lecture:	PPT Completed document of full-wave rectifier Lab. #5

			Ability to analyse the Flyback/Forward converter operations. Ability to simulate the Flyback/Forward Converter. Ability to build Flyback.		Demonstrate how to use Matlab/Simulink for building a case study Flyback/Forward converter as well as the plot of the waveform Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation for 1 case study Recall the format of the report and the deadline to submit the report. Monitor on Lab. #5: 25W Flyback Converter	Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on the group findings (***only for assigned students***) Submit a synthesis report of the case study. Continuous working on Lav. #5	***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides & 3 minutes presentation. Lab & assignment: hardware and report	
15-16	4/4/4	CLO1 CLO2 CLO3	Ability to compute the Push-Pull Converter, Half-Bridge, and Full-Bridge Converter Ability to analyse the push-pull, half/full bridge converter operations. Ability to simulate the push-pull/half-bridge/full-bridge Converter with a case study.	Lecture 8: DC-Power Supply Part 2	Lecture on a Push-Pull/Half-bridge/Full-bridge Converter Lecture on device selection for a case study problem. Demonstrate how to use Matlab/Simulink for building a case study Flyback/Forward	Review how to use software (Matlab/Simulink, Spice) in the rectifier system. Working as a group of two students on the provided topic for the selected names. Teach or instruct others in the class on	Progressive report and presentation according to lecture: ***Rubrics*** (devices, construct PE, Modeling PE, prototype, Report) 5 slides: intro device model conclusion, 3	

					converter as well as the plot of the waveform Provide 12-15 problems (case study) Assign students as a group responsible for the oral presentation for 1 case study Recall the format of the report and the deadline to submit the report.	the group findings (***only for assigned students***) Submit a synthesis report of the case study. Submit Lab. Report Oral presentation on Lab	minutes presentation. Lab & assignment: hardware and report	
17	**2**	**CLO1**					**Final exam**	**Final doc.**

Appendix B: Example of Table of Specifications (Course: Power Electronics, Year 4, Semester 1)

Week	Topics	Learning Outcomes	SLT	Assessment Techniques	Learning Domain (LD)	CLOs	Cognitive Level						Question Number	Weighting	Total Score
							C1	C2	C3	C4	C5	C6			
6	Rectifier Circuit	- Ability to compute the half- and full-wave rectifier with Diode and E5with Thyristor - Ability to analyse the half- and full-wave rectifier operation for different load types. - Ability to compute the 3-phase rectifier with 6 Diodes/Thyristor. - Ability to analyse the 3-phase rectifier operation for different load types.	6	Online Quiz 1 (Multiple choice)	LD1	CLO1	1	1	3				5	Q1-Q5 = 1 point each	5 points
7			2	Midterm (Written Exam)	LD2		1	1	2			1	5	Q1 = 2 points, Q2-Q3 = 4 points, Q4-Q5 = 5 points	20 points
12	DC-DC Isolated Converter	- Ability to compute the Buck, Boost, and Buck-Boost Converter - Ability to analyse the Buck, Boost, and Buck-Boost Converter operation.	5	Online Quiz 2 (Multiple choice)	LD1		1	1	3				5	Q1-Q5 = 1 point each	5 points
17	DC Power Supply	- Ability to compute the Flyback, Forward, Push-Pull Converter, Half-Bridge, and Full-Bridge Converter - Ability to analyse the Flyback, Forward, Push-Pull Converter, Half-Bridge, and Full-Bridge Converter operations.	6	Final (Written Exam)	LD2		1 1	1 1				1 1		Q1-Q4 = 2 points, Q5-Q6 = 6 points	20 points
			19												50 points

Appendix C: Rating scale example 1: Interpersonal skills assessment

COMM 0001 – Business Communications

Objective: The student will demonstrate the ability to work well with other people. Criteria for success: Each statement must be at a level of "Average" or better.

Instructor:_____ Date: _____ Student name:____ Student ID: __

Team Skills	Poor 1	Weak 2.5	Average 3	Good 4	Excellent 5
People skills					
Communication skills					
Contribution to the work done					
Contributions to meetings					
Arrives on time to meetings					
Based on team agreement, place a check mark in the appropriate box in each row.					
Comments:					

Appendix D: Rating scale example 2: Practicum performance assessment

Expected learning outcome: The student will demonstrate professionalism and high-quality work during the practicum.
Criteria for success: A maximum of one item is rated as "Needs improvement" in each section.

Performance Area	Needs Improvement	Average	Above Average	Comments
A. Attitude				
Punctual				
Respectful of equipment				
Uses supplies conscientiously				
B. Quality of work done				
• ...				
Above average = Performance is above the expectations stated in the outcomes. Average = Performance meets the expectations stated in the outcomes. Needs improvement = Performance does not meet the expectations stated in the outcomes.				

Appendix E: Rating scale example 3: Tools handling assessment

Expected learning outcome: The student will select the proper tool for each task and use it both skilfully and safely.
Criteria for success: All skills must be performed “Average” or better.

Skill	Unacceptable 0	Weak 2.5	Average 3	Good 4	Excellent 5	Weight	Score
Selects the proper tool						1	
Uses the tool skilfully						5	
Uses the tool safely						2	
						Total	

Appendix F: Rating scale example 4: Computer program quality assessment

Expected learning outcome: The student will write efficient, documented, error-free computer programs that meet the specifications.
Criteria for success: A maximum of one item is rated as "Below expectations".

Computer Program	Below Expectations	Meets Expectations	Exceeds Expectations	Comments
Achieves what it was designed to do				
Operates without errors				
Source code is efficient				
Source code is well-documented				

Exceeds expectations = Performance is above the expectations stated in the outcomes.
Meets expectations = Performance meets the expectations stated in the outcomes.
Below expectations = Performance does not meet the expectations stated in the outcomes.

Appendix G: Rating scale example 5: Written report assessment

Expected learning outcome: The student will write a report that recommends one piece of equipment over another based on the pros and cons of each.
Criteria for success: All items must be rated as "Weak" or above.

Report	Unacceptable 0	Weak 2.5	Average 3	Good 4	Excellent 5	Weight	Score
Introduction						1	
Main Body						5	
Summary						1	
						Total	

Appendix H: Rating scale example 6: Presentation performance assessment

Expected learning outcome: The student will give a presentation that defends their marketing approach for their assigned product.
Criteria for success: Only one item is rated less than "Slightly agree".

Presentation Skill	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
His/her voice was clearly heard						
His/her tone of voice was varied						
The pace was appropriate						
The language level was appropriate						

Appendix I: Sample of Tasks According to Bloom's Taxonomy

Bloom's Revised Taxonomy Domains and levels	Major Domain	Learning Domain	CLOs	Sample Assessment methods	Sample assessment tasks	Sample Assessment criteria	Sample Assessment Rubric
Cognitive	MD1: Knowledge	LD1: Knowledge	Ability to apply basic ***knowledge*** of power electronics components, power electronics structure, and its application in Electronics and Automation (EA) and Electrical Energy (EE) fields. (C3)	Performance (class activity, role play) Project Posters Practicum/field work **Simulation** Case studies (real-life problem and proposed a solution) Lab experiment **Case study**	***Simulation** **Task Description:** Design and simulate a half-wave rectifier circuit using a simulation software of your choice (MATLAB Simulink). Select appropriate components, such as a diode and a load resistor, and determine the necessary values for the components based on given specifications (e.g., input voltage, load resistance). Run the simulation to observe the output waveform and calculate the rectification efficiency. Prepare a report summarizing your design process, simulation results, and conclusions. ***Case Studies: Fluctuation of Electric Power Consumption** **Task Description:** Use the principles of electronic power theory, Demonstrate the problems associated with electric	***Simulation** Ability to compute the half-wave rectifier with Diode. Ability to organize the half-wave rectifier operation and device selection. Ability to simulate the half-wave rectifier with case study. ***Case Study:** Ability to apply each related theories to the real electric power consumption Ability to discover the factors that cause electric power consumption change in the same condition and different seasons	Cannot relate the theory and discover the factors: 0 Can relate the theory and discover one factor: 1 Can relate the theory and discover two factors: 2 Can relate the theory and discover more than two factors: 3

					power consumption fluctuations. Provide examples of how power consumption varies under the same conditions between the dry and rainy seasons.	Able to apply the theoretical knowledge and perform work in the laboratory independently or relate to the real life	
	MD2: Cognitive skills	LD2: Cognitive skills	Ability to ***design a suitable and economical*** power electronics converter for requirement specification (C6)	Written test **Debates** Mock court Essay Experiment Project Performance test **Case study**	***Debates** **Topic: Energy Efficiency vs. Cost-effectiveness** **Task Description:** Teams will debate whether prioritising energy efficiency or cost-effectiveness is more important when selecting a power supply topology for a specific application. Each team will evaluate and present arguments for their assigned topology, emphasizing how it excels in either energy efficiency or cost-effectiveness. The goal is to evaluate and determine which factor should carry more weight in the decision-making process. *** Case Study** **Topic: Select the most effective method to predict power electronics reliability between "Use of Field Data Analysis and Reliability Prediction Software"** To predict the reliability of power electronics, it involves the assessing on the	***Debates** Ability to find relevant support documents/data Ability to explain to the audience and experts Ability to determine the strengths of one topic and the weaknesses of another ***Case Study** Ability to collect adequate field data and analysis on the key parameters Ability to use Reliability Prediction software correctly (following SOP) Ability to find other secondary support document on the two methods	***Debates** No relevance of the arguments presented: 0 Present relevance of the arguments without reliable source: 1 Present relevance of the arguments with reliable sources: 2 *** Case Study** Cannot collect adequate field data and analysis: 0 Collect adequate field data and cannot analyze on the key parameter: 1

					likelihood of failure or degradation over time. There are two methods that can be used to predict power electronics reliability including Field Data Analysis (monitoring key parameters such as temperature, voltage, current, and operating hours) and Reliability Prediction Software (utilise mathematical models, algorithms, and historical data to predict the reliability of power electronics systems). The students are asked to perform the two methods, upload the information/data in google drive and compare the results then make a conclusion on the most effective method.		Collect adequate field data and analyze all key parameters: 2 Collect adequate field data, analyze and interpret without support document: 3 Collect adequate field data, analyze and interpret with support document: 4 Cannot use Reliability Prediction Software correctly: 0 Can use reliability prediction software correctly with support from instructor: 1 Can use reliability prediction software correctly without support from instructor: 2

							Can use reliability prediction software correctly and interpret the result without support document: 3 Can use reliability prediction software correctly and interpret the result with support document: 4 Are not able to select the most effective method based on the evidence: 0 Are able to select the most effective method based on the evidence: 1

Psychomotor	MD3: Psychomotor/Technical skills	LD3: Psychomotor skills/ Technical Skills	Ability to ***design a suitable and economical*** power electronics converter for requirement specification (P7)	Portfolio Brigde rectifier modeling Presentation Report Article Publication	Design buck converter which has the input voltage of 12V and output voltage of 5V and output current of 10A.	Ability to create a dc-dc converter to meet a specific requirement	Cannot perform the task: 0 Can perform with major moderator: 1 Can perform with minor moderator: 2 Can perform independently: 3
Affective	MD4: Interpersonal skills and responsibility	LD5: Responsibility	Ability to develop ***teamwork*** skills, ***presentation skills, and technical writing skills appropriate for*** scientific and non-scientific communities (A5)	Role play Essay Posters **Project** Presentation Prototype Performance Task Journal Research	**Project:** Buck Converter Design Design specifications: Input voltage Vin = 20V, Output voltage Vout = 9V, Power P = 1w, and Ripple voltage less than 2%. * Tasks: Form a team of 5 students Assign the role and responsibility of each team member. Design a modeling for Buck Converter based on topology in the lesson. Calculate the size of capacitor to meet the requirement. According to your design, build a simulation model using MATLAB and plot input, output waveforms, and show the ripple voltage of output. Select the hardware components based on your design.	Identify the safety criteria in Engineering Lab using MCQs Be able to listen to summary the team meeting Indicate the safety process during on board experiment by submit a report step by step. Be able to collaborate in the team work by answer question in the google forms. Be able to demonstrate the safety criteria accurately Be able to complete the assigned task by meet the deadline Be able to integrate the safety to all the experiment Be able to formulate the role and activity of the team level Be able to maintain the team working actively	*Safety criteria: Poor (correct <40%): Not remember about safety criteria Average (correct 40%-70%): Remember some safety criteria Good (correct 70%-90%): Mostly remember safety criteria Very good (over 90%): Remember safety criteria very well * Summary report of team meeting: Poor: not cover what the team discussion

					Construct the circuit on breadboard then show the result of input/output waveform, and ripple voltage.		Average: cover some information of the team discussion Good: mostly cover the information of the team discussion Very good: cover all of information of the team with good summary * Follow safety step: Poor (<40%): not follow the safety criteria Average (40%-70%): follow some safety criteria Good (70%-90%): mostly follow the safety criteria Very good (over 90%): follow the safety criteria very well * Level of collaborate: Poor (score <40%): never complete tasks? that team set

							Average (score 40%-70%): complete some tasks that team set Good (score 70%-90%): mostly complete the task that team set Very good (over 90%): mostly complete the task that team set and support another member * Check list for teacher evaluates for student safety: poor: always make mistake on safety during experiment average: make some mistake on safety during experiment Good: never make mistake on safety during experiment Very good: never make mistake on safety during experiment with

							well organize the tools * Complete the task: Poor: always behind the schedule Average: just sometimes behind the schedule Good: always complete the task on time Very good: always complete the task before deadline with quality *team work poor: always late submission average: on schedule submission good: before schedule 1-3 days submission very good: Before schedule submission with extra report supports *team work

							Work plan (0 = does not likely cooperate, 1 = Not trying to cooperate with fellow friends, 2 = Less trying to cooperate with fellow friends, 3 = Trying to cooperate with fellow friends Team meeting at least 4 (0 = 0 or 1 time, 1 = 2 times, 2 = 3times, 3 = 4 times, 4 = more than 4 times)
	MD5: Communication, information technology and numerical skills	LD8: Communication	Ability to conduct presentation on Power electronics system to scientific and non-scientific communities .(A5)				

Appendix J: Examples of assessment tasks by domains and levels

Domain	Major Domain	Learning Domain	CLOs	Levels	Potential Assessment methods	Sample assessment tasks	Sample Assessment criteria	Sample Assessment Rubric
Cognitive (6 levels)	MD1: Knowledge	LD1		C1	- MCQs (terms, facts and concepts) - Fill in the blank (terms, facts and concepts) -Labelling - Short answer test - Writing test - Performance test - Matching - Presentation (Summarizing, reciting) - Puzzles	***MCQ** Select What is the primary function of a diode in an electrical circuit? A) Amplify signals B) Store electrical energy C) Control the flow of current D) Convert AC to DC ***Presentation** Describe the importance of power electronics components in various electrical systems.	**No assessment criteria** - Remember the definition of key words/scientific/technical words/component - Independent to perform the tasks - Remember the term to fill in the blank - Remember to main composition used for labelling	***MCQ** Can identify the primary function of a diode: 1 Cannot identify the primary function of a diode: 0
	MD2: Cognitive skills	LD2:		C2	- MCQs - Short answer test (compare and contrast two or more theories, process) - Presentation (interpreting or explaining information) - Class discussion - Essay - Posters - Paraphrasing information - Writing test	***Essay** **Task Description:** Provide a written explanation of how a DC power supply works. Describe the main components, such as transformers, rectifiers, and voltage regulators, and their roles in converting AC voltage to regulated DC voltage. Use diagrams or illustrations to support	***Essay** - Clear and coherent explanation of the functionality of a DC power supply. - Accurate identification and description of key components. - Use of diagrams or illustrations to enhance understanding. ***Writing Test**	***Writing test** - Cannot compare and give example of each application: 0 - Can compare and cannot give example of each application: 1 - Can compare and can give at least one example of each application: - Can compare and can give all examples of each application: 4

						your explanation. ***Writing test** **Task Description:** Based on definition and types of power electronic converters, please compare each type of converters and their applications in real electrical systems?	- Ability to identify the difference of each type of power electronic converters and give at least one example of each type in real electrical systems. - Student create their own definition or explanation of the concept - Students are able to summarise what they have learnt so far during the session using their own word -Rephrase their paragraph to suit to meaning #Problem solving MCQs	
	MD4		Ability to apply basic ***knowledge*** of power electronics components, power electronics structure, and its application in the EA and EE field. (C3)	C3	ITC 'Assessment Method_C'!C4(3)'!E17:E18- Performance (class activity, role play) - Project - Posters - Practicum/field work - Simulation - Case studies (real-life problem and proposed a solution) - Lab experiment - Case study			

	MD5			C4	- Essay writing - Written report - Portfolios - Debates - Case studies - SWOT - Performance test - Project - Presentation (Problem with multiple cause and determine the most likely cause) - Research	***Written Report** **Task Description:** By providing information from theories, simulation software, practical experiments, and case studies (Topology specifications, Components and operation). Compare and contrast different types of DC power supply topologies, such as linear regulators, switching regulators (buck, boost, buck-boost), and flyback converters. Analyse the advantages, disadvantages, and typical applications of each topology. Consider factors such as efficiency, voltage regulation, cost, and size.	***Written Report** - Ability of students to compare and contrast different types of DC power supply topologies - Ability of students to analyse the characteristics of each types of DC power supply topologies and their application - Ability of students to prepare report follows the given guideline	- Cannot analyse the given data: 0 - Can analsze and compare the different types of DC power supply topologies but cannot prepare the report: 1 - Can analyse, use the data and write report follow the guideline:2
				C5	- Written test - Debates - Mock court - Essay - Experiment - Project - Performance test - Case study	***Debates** **Topic: Energy Efficiency vs. Cost-effectiveness** **Task Description:** Teams will debate whether prioritising energy efficiency or cost-effectiveness is more important when selecting a power supply topology for a specific application. Each team will evaluate and present arguments for their assigned topology,	***Debates** - Ability to find relevant support documents/data - Ability to explain to the audienvr and experts - Ability to determine the strengths of one topic and the weaknesses of another ***Case Study**	***Debates** - No relevance of the arguments presented: 0 - Present relevance of the arguments without reliable source: 1 - Present relevance of the arguments with reliable sources: 2 *** Case Study** - Cannot collect adequate field data and analysis: 0

						emphasizing how it excels in either energy efficiency or cost-effectiveness. The goal is to evaluate and determine which factor should carry more weight in the decision-making process. *** Case Study** **Topic: Select the most effective method to predict power electronics reliability between "Use of Field Data Analysis and Reliability Protection Software"** To predict the reliability of power electronics, it involves assessing the likelihood of failure or degradation over time. There are two methods that can be used to predict power electronics reliability including Field Data Analysis (monitoring key parameters such as temperature, voltage, current, and operating hours) and Reliability Prediction Software (utilize mathematical models, algorithms, and historical data to predict the reliability of power electronics systems). The students are asked to perform the two methods,	- Ability to collect adequate field data and analysis on the key parameters - Ability to use Reliability Prediction software correctly (following SOP) - Ability to find other secondary support documents on the two methods	- Collect adequate field data and cannot analyze on the key parameter: 1 - Collect adequate field data and analyze all key parameters: 2 - Collect adequate field data, analyze and interpret without support document: 3 - Collect adequate field data, analyze and interpret with support document: 4 - Cannot use Reliability Prediction Software correctly: 0 - Can use reliability prediction software correctly with support from instructor: 1 - Can use reliability prediction software correctly without support from instructor: 2 - Can use reliability prediction software correctly and interpret the result without support document: 3 - Can use reliability prediction software correctly and interpret the result with support document: 4 - Are not able to select the most effective method

						upload the information/data in google drive and compare the results then make a conclusion on the most effective method.		based on the evidence: 0 - Are able to select the most effective method based on the evidence: 1
			Ability to design a suitable and economical power electronics converter for requirement specification . (C6)	C6:	- Presentation - Essay - Journal - Report writing - Prototype or model - Composition - Performance tasks - Research - Project - Business plan			
Psychomotor (7 levels)	MD3	LD3		P1	- MCQ - Presentation - Short answer test - Puzzle - Summarize - Mix and match	Provide specification of diode to students. Then let them read the specification of a given diode, MOSFEF, IGBT.... Example: power diode SNK 70/12	Ability to read the specification of diode	Cannot read igbt/diode specs: 0 Can read igbt/diode specs <50%: 1 Can read igbt/diode specs <75%: 2 Can read igbt/diode specs >75%: 3
				P2	- Performance test - Role-playing - Presentation - Report	Form a group of students (3-5) and provide one sample of igbt/diode to each group. Then explain IGBT characteristic of Semikron SKM195GB066D of provided sample.	Ability to describe and explain the IGBT characteristic	Cannot explain igbt/diode characteristic: 0 Can explain igbt/diode characteristic with moderate guidence: 1 Can explain igbt/diode characteristic with minimal guidance: 2 Can explain igbt/diode characteristic independently: 3

	MD5:Communication, information technology, and numerical skills			P3	- Presentation - Progressive report - Performance test - Draft/draw sample of bridge rectifier	Provide Sample of full bridge rectifier to students. Then let them draw the diagram of full bridge rectifier for single phase ac supply based on the provided sample with instruction from lecture.	Ability to understand and reproduce the draw diagram of diode rectifier	Cannot draw diagram: 0 Can draw diagram with more error: 1 Can draw diagram with less error: 2 Can draw diagram without error: 3
				P4		A power diode is given, connect halfwave uncontrolled rectifier for AC single phase supply 230V in lab and measure the output voltage waveform and diode waveform	Ability to set up experiment of simple rectifier	Cannot perform the task: 0 Can perform the test steps with guided hesitation: 1 Can performing the correct test steps in a guided manner: 2 Can performs test steps precisely without guidance: 3
				P5	- Set up experiment - Presentation - Measuring data information - Report	Build the full wave uncontrolled rectifier for 3 phase AC supply. The rectifier is filtered by the L-C low pass filter. Measure output waveform and diode waveform.	Ability to set up complex circuit of rectifier and L-C low pass filter.	Cannot perform the task: 0 Can perform the test steps with guided hesitation: 1 Can performing the correct test steps in a guided manner: 2 Can performs test steps precisely without guidance: 3
				P6	- Set up more complex experiment - Construct modeLling (mini scale for testing in lab) - Solve-fix error - Report	Propose the design AC-DC power supply where the input voltage of AC single phase 230V and output is 12V	Ability to propose design rectifier with lower voltage level based on step down transformer and rectifier	Cannot perform the task: 0 Can perform with major moderator: 1 Can perform with minor moderator: 2

								Can perform independently: 3
			Ability to ***design a suitable and economical*** power electronics converter for requirement specification . (P7)	P7	- Organize bridge rectifier modeling - Presentation - Report			
Affective (5 levels)	MD4			A1	Quiz, MCQ, Puzzle, Face to face oral, Summary report, Written exam, Project	Project: Buck Converter Design Design specifications: Input voltage Vin = 20V, Output voltage Vout = 9V, Power P = 1w, and Ripple voltage less than 2%. * Tasks: - Form a team of 5 students - Assign the role and responsibility to each team member. - Design a modeling for Buck Converter based on topology in the lesson. - Calculate the size of capacitor to meet the requirement. - According to your design, build a simulation model using	- Identify the safety criteria in Engineering Lab using MCQs - Be able to listen to summary the team meeting	* Safety criteria: • Poor (correct <40%): Not remember about safety criteria • Average (correct 40%-70%): Remember some safety criteria • Good (correct 70%-90%): Mostly remember safety criteria • Very good (over 90%): Remember safety criteria very well * Summary report of team meeting: • Poor: not cover what the team discussion • Average: cover some information of the team discussion • Good: mostly cover the information of the team discussion

						MATLAB and plot input, output waveforms, and show the ripple voltage of output. - Select the hardware components based on your design. - Construct the circuit on breadboard then show the result of input/output waveform, and ripple voltage. - Design a PCB for your Buck converter using KiCAD. - Print out the board, and shouldering all the components. - Test your board and give the waveform of input/output, and the ripple voltage. * Students must follow the safety criteria for Engineering Lab. * Submit requires: - Work plan and weekly meeting report. - Technical report and PCB board demo. - Presentation for your work in 10min. * Beside the assessment for Cognitive and Psychomotor, we also		• Very good: cover all of information of the team with good summary
		LD5		A2	Written exam, Project (group), Lab experiment, Presentation, Quiz		- Indicate the safety process during on board experiment by submit a report step by step. - Ability to collaborate in the team work by answer question in the google forms.	* Follow safety step: • Poor (<40%): not follow the safety criteria • Average (40%-70%): follow some safety criteria • Good (70%-90%): mostly follow the safety criteria • Very good (over 90%): follow the safety criteria very well * Level of collaborate: • Poor (score <40%): never complete that team provide • Average (score 40%-70%): complete some tasks that team provide • Good (score 70%-90%): mostly complete the task that team provide • Very good (over 90%): mostly complete the task that team provide and support another members
				A3	Long project, Case study, Written exam, Quiz, Presentation		- Be able to demonstrate the	* Check list for teacher evaluate for student safety:

						concern Affective which focus on: - Team work - Safety	safety criteria accurately - Ability to complete the assigned task by meet the deadline	• poor: always make mistake on safety during experiment • average: make some mistake on safety during experiment • Good: never make mistake on safety during experiment • Very good: never make mistake on safety during experiment with well organize the tools * Complete the task: • Poor: always behind the schedule • Average: just sometimes behind the schedule • Good: always complete the task on time • Very good: • always complete the task before deadline with quality
	MD5			A4	Project, Case study, Poster, Written exam, Debate, Prototype,		- be able to integrate the safety to all the experiment - be able to formulate the role and activity of the team	*Team work • poor: always late submission • average: on schedule submission • good: before schedule 1-3 days submission • very good: Before schedule submission with extra report supports

		LD8	Ability to develop presentation skills, technical writing skills, and teamwork of power electronics systems in scientific and non-scientific communities. (A5)	A5	Role play, essay, Posters, Project, Presentation, Prototype, Performance Task, Journal, Research			

Appendix K: Nomination of Lead Committee, Technical Committees and Secretariat

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងអប់រំ យុវជន និងកីឡា
លេខ: ៥២៦៤ អយក.ប្រ

លិខិតឧទ្ទេសនាម

យោង៖ - Inception Report របស់អ្នកជំនាញការអន្តរជាតិផ្នែកការរៀបចំក្របខ័ណ្ឌអភិវឌ្ឍកម្មវិធីសិក្សាតាមបែបការអប់រំផ្អែកលើលទ្ធផល
- កំណត់ហេតុប្រជុំស្តីពីការកែការរៀបចំក្របខ័ណ្ឌអភិវឌ្ឍកម្មវិធីសិក្សាតាមបែបការអប់រំផ្អែកលើលទ្ធផលចុះថ្ងៃទី២១ ខែធ្នូ ឆ្នាំ២០២៣។

ថ្នាក់ដឹកនាំ និងបុគ្គលិកអប់រំនៃក្រសួងអប់រំ យុវជន និងកីឡា ដូចមានរាយនាមខាងក្រោម ត្រូវបានចាត់តាំងជាគណៈកម្មការដឹកនាំ គណៈកម្មការបច្ចេកទេស និងក្រុមការងារលេខាធិការដ្ឋាន ដើម្បីរៀបចំ **ក្របខ័ណ្ឌអប់រំ អនាគតផល សម្រាប់ការអប់រំផ្អែកលើលទ្ធផលនៅឧត្តមសិក្សាកម្ពុជា** និង **គោលការណ៍ណែនាំស្តីពី កម្មវិធីសិក្សាបរិវត្តន៍ គោលការណ៍ណែនាំស្តីពី គរុកោសល្យនវានុវត្តន៍** និង **គោលការណ៍ណែនាំស្តីពី សមាហរណកម្មលទ្ធផលសិក្សា**។

ក. គណៈកម្មការដឹកនាំ

១.	ឯកឧត្តមបណ្ឌិត	សាន	វឌ្ឍនា	រដ្ឋលេខាធិការក្រសួងអប់រំ យុវជន និងកីឡា	ប្រធាន
២.	ឯកឧត្តមបណ្ឌិត	សោម	រតនា	អនុរដ្ឋលេខាធិការក្រសួងអប់រំ យុវជន និងកីឡា	អនុប្រធាន
៣.	ឯកឧត្តម	ម៉ក់	ងយ	អគ្គនាយក អគ្គនាយកដ្ឋានឧត្តមសិក្សា	អនុប្រធានអចិន្ត្រៃយ៍
៤.	ឯកឧត្តមបណ្ឌិត	ប៉ូ	គីមថូ	នាយកវិទ្យាស្ថានបច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៥.	ឯកឧត្តមបណ្ឌិត	ជេត	ជាលី	សាកលវិទ្យាធិការ សាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ	សមាជិក
៦.	ឯកឧត្តមបណ្ឌិត	ង៉ោ	ប៊ុនថាន	សាកលវិទ្យាធិការ សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក
៧.	ឯកឧត្តម	សុខ	ឃន	សាកលវិទ្យាធិការ សាកលវិទ្យាល័យជាតិបាត់ដំបង	សមាជិក
៩.	ឯកឧត្តម	ទុំ	សារ៉ាវុធ	សាកលវិទ្យាធិការ សាកលវិទ្យាល័យស្វាយរៀង	សមាជិក
១០.	លោកបណ្ឌិត	និត	ប៊ុនខ្មៀ	អគ្គនាយករង អគ្គនាយកដ្ឋានឧត្តមសិក្សា	សមាជិក
១១.	លោក	ឃួ	រ៉ែ:	អគ្គនាយករង អគ្គនាយកដ្ឋានឧត្តមសិក្សា	សមាជិក
១២.	លោក	គង់	ភូមីកា	ប្រធាននាយកដ្ឋានគ្រប់គ្រងឧត្តមសិក្សា	សមាជិក
១៣.	លោកបណ្ឌិត	ហេង	គ្រែង	ប្រធាននាយកដ្ឋានស្រាវជ្រាវនិងនវានុវត្តន៍	សមាជិក

គណៈកម្មការដឹកនាំ មានតួនាទី និងភារកិច្ច ដូចខាងក្រោម ៖

- ដឹកនាំ និងគ្រប់គ្រងដំណើរការរៀបចំក្របខ័ណ្ឌអប់រំអនាគតផល និងគោលការណ៍ណែនាំ
- ពិនិត្យ និងផ្តល់យោបល់លើការរៀបចំក្របខ័ណ្ឌអប់រំអនាគតផល និងគោលការណ៍ណែនាំ

អាសយដ្ឋានលេខ៨០ មហាវិថី ព្រះនរោត្តម ភ្នំពេញ កម្ពុជា ទូរស័ព្ទ: (៨៥៥-២៣) ២២០ ៦៧៣ / ២២០ ៣០៤ ទូរសារ: (៨៥៥-២៣) ២១៧ ២៥០ / ២១២ ៥១២
អ៊ីមែល: info@moeys.gov.kh / administration@moeys.gov.kh គេហទំព័រ : www.moeys.gov.kh

- ផ្តល់ការគាំទ្រដល់គ្រឹះស្ថានឧត្តមសិក្សាសម្រាប់ធ្វើទំនើបកម្មកម្មវិធីអប់រំស្របតាមក្របខណ្ឌអប់រំអនាគតផល សម្រាប់ការអប់រំផ្តែកលើលទ្ធផលនៅឧត្តមសិក្សាកម្ពុជា
- សមាជិក សមាជិកា ចូលរួមប្រជុំតាមការអញ្ជើញរបស់ឯកឧត្តមប្រធាន។

ខ. គណៈកម្មការបច្ចេកទេស

១.	ឯកឧត្តម	ម៉ក់	ងយ	អគ្គនាយកនៃអគ្គនាយកដ្ឋានឧត្តមសិក្សា	ប្រធាន
២.	លោកបណ្ឌិត	កៅ	សុវណ្ណសុផល	ប្រធានការិ. នា.គ្រប់គ្រងឧត្តមសិក្សា	អនុប្រធាន
៣.	លោកបណ្ឌិត	ហេង	គ្រែង	ប្រធាននាយកដ្ឋានស្រាវជ្រាវនិងនវានុវត្តន៍	សមាជិក
៤.	លោកបណ្ឌិត	ជ័យ	ចាន់អឿន	ព្រឹទ្ធបុរសរង សាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ	សមាជិក
៥.	លោកបណ្ឌិត	អោម	សុខជា	ប្រធានដេប៉ាតឺម៉ង់ វិ.បច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៦.	លោកស្រីបណ្ឌិត	ចែម	មួយលីន	មន្ត្រី សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក
៧.	លោកបណ្ឌិត	សុក	សាយ	ទីប្រឹក្សាបច្ចេកទេសគម្រោងHEIP	ទីប្រឹក្សា
៨.	Prof. Dr.	Aida	Suraya Md. Yunus	អ្នកជំនាញការអន្តរជាតិផ្នែកOBE	ទីប្រឹក្សា
៩.	Prof. Dr.	Wan	Zuhainis Saad	អ្នកជំនាញការអន្តរជាតិផ្នែកOBE	ទីប្រឹក្សា

គណៈកម្មការបច្ចេកទេស មានអនុគណៈកម្មការបួនគឺ៖ អនុគណៈកម្មការរៀបចំក្របខ័ណ្ឌអប់រំអនាគតផលសម្រាប់ការអប់រំផ្តែកលើលទ្ធផលនៅឧត្តមសិក្សាកម្ពុជា (FutureFit Educational Framework for Outcome-Based Education in Cambodian Higher Education) អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីកម្មវិធីសិក្សាបរិវត្តន៍ (Guideline on Transformative Curriculum) អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីតរុកោសល្យនវានុវត្តន៍ (Guideline on Innovative Pedagogy) និង អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីសមាវាយតម្លៃលទ្ធផលសិក្សា (Guideline on Holistic Assessment)។

ខ.១. អនុគណៈកម្មការរៀបចំក្របខ័ណ្ឌអប់រំអនាគតផលសម្រាប់ការអប់រំផ្តែកលើលទ្ធផល

១.	លោកបណ្ឌិត	កៅ	សុវណ្ណសុផល	ប្រធានការិ. នា.គ្រប់គ្រងឧត្តមសិក្សា	ប្រធាន
២.	លោក	សួយ	ទី	នាយករង វិទ្យាស្ថានបច្ចេកវិទ្យាកម្ពុជា	សហប្រធាន
៣.	លោក	ប៉ាល់	ដៃស	សាកលវិទ្យាធិការរង សា.ភូមិន្ទភ្នំពេញ	សមាជិក
៤.	លោកស្រីបណ្ឌិត	សេង	មុំ	សាកលវិទ្យាធិការរង សា.ភូមិន្ទកសិកម្ម	សមាជិក
៥.	លោក	ឡឹក	រិះ	សាកលវិទ្យាធិការរង សា.ស្វាយរៀង	សមាជិក
៦.	លោក	ទេព	នារ៉ា	សាកលវិទ្យាធិការរងសា.ជាតិបាត់ដំបង	សមាជិក

ខ.២. អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីកម្មវិធីសិក្សាបរិវត្តន៍

១.	លោក	ជួរ	ចាន់ណារិទ្ធ	មន្ត្រីនាយកដ្ឋានគ្រប់គ្រងឧត្តមសិក្សា	ប្រធាន
២.	លោកបណ្ឌិត	អោម	សុខជា	ប្រធានដេប៉ាតឺម៉ង់ វិ.បច្ចេកវិទ្យាកម្ពុជា	សហប្រធាន
៣.	លោកបណ្ឌិត	ឃុន	តឹមលាង	ប្រធានដេប៉ាតឺម៉ង់ សា.ភូមិន្ទភ្នំពេញ	សមាជិក
៤.	លោក	រៀន	រង្ស	អនុប្រធានដេប៉ាតឺម៉ង់ សា.ជាតិបាត់ដំបង	សមាជិក
៥.	កញ្ញា	ហ៊ាន	និមល	មន្ត្រីនាយកដ្ឋានគ្រប់គ្រងឧត្តមសិក្សា	សមាជិក

៦.	លោកស្រីបណ្ឌិត	ចែម	មួយលីន	មន្ត្រី សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក
៧.	លោក	ម៉ម	ឧត្តរ	គ្រូបង្រៀនសាកលវិទ្យាល័យស្វាយរៀង	សមាជិក
៨.	កញ្ញា	ឡូ	ស្រីងែត	មន្ត្រី សាកលវិទ្យាល័យជាតិបាត់ដំបង	សមាជិក
៩.	កញ្ញាបណ្ឌិត	អោម	សុខា	ជំនួយការបច្ចេកទេសគម្រោងHEIP	សមាជិក

ខ.៣. អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីការអោសល្យនិងសុវត្ថិភាព

១.	លោកស្រី	ហួយ	សុច័ន្ទ	អនុប្រធានការិ.នា.គ្រប់គ្រងឧត្តមសិក្សា	ប្រធាន
២.	លោកបណ្ឌិត	ស្រាន	ពៅ	ព្រឹទ្ធបុរស សាកលវិទ្យាល័យជាតិបាត់ដំបង	សហប្រធាន
៣.	លោក	គង់	ថុង	ព្រឹទ្ធបុរស សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក
៤.	លោកស្រីបណ្ឌិត	ប៊ិច	សុភាព	ព្រឹទ្ធបុរសរង វិទ្យាស្ថានបច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៥.	លោកបណ្ឌិត	ជា	ស៊ីណាត	អនុប្រធានការិ. នា.ស្រាវជ្រាវនិងនវានុវត្តន៍	សមាជិក
៦.	លោក	ជូ	កុសល្យ	សាស្ត្រាចារ្យ វិទ្យាស្ថានបច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៧.	លោកបណ្ឌិត	ស្រ៊ីវ	ថាវិទ្ធ	គ្រូបង្រៀនសាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ	សមាជិក
៨.	លោកបណ្ឌិត	ខឹមកុន	ស៊ុនលី	គ្រូបង្រៀន សាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ	សមាជិក
៩.	លោក	ជួន	កក្តី	គ្រូបង្រៀន សាកលវិទ្យាល័យស្វាយរៀង	សមាជិក
១០.	លោក	ជូ	ម៉ានិត	គ្រូបង្រៀន សាកលវិទ្យាល័យស្វាយរៀង	សមាជិក
១១.	លោក	ឌឹម	កាណាន់	គ្រូបង្រៀន សា.ភូមិន្ទកសិកម្ម	សមាជិក
១២.	កញ្ញា	ឡុង	ស្រីពៅ	គ្រូបង្រៀន សា.ភូមិន្ទកសិកម្ម	សមាជិក

ខ.៤. អនុគណៈកម្មការរៀបចំគោលការណ៍ណែនាំស្តីពីសមាទាយតម្លៃលទ្ធផលសិក្សា

១.	កញ្ញា	ប៊ុនរី	រីនណា	ប្រធានការិ. នា.គ្រប់គ្រងឧត្តមសិក្សា	ប្រធាន
២.	លោកបណ្ឌិត	ជ័យ	ចាន់អឿន	ព្រឹទ្ធបុរសរង សាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ	សហប្រធាន
៣.	លោកបណ្ឌិត	ជ្រិន	ផុក	ប្រធានដេប៉ាតឺម៉ង់ វិ.បច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៤.	លោក	ហែម	សុន្ទរវឌ្ឍន៍	ប្រធានដេប៉ាតឺម៉ង់ សា.ស្វាយរៀង	សមាជិក
៥.	កញ្ញា	ហ៊ិន	ស៊ីយ៉ា	ប្រធានដេប៉ាតឺម៉ង់ សា.ជាតិបាត់ដំបង	សមាជិក
៦.	លោក	លឹម	តឹង	គ្រូបង្រៀនវិទ្យាស្ថានបច្ចេកវិទ្យាកម្ពុជា	សមាជិក
៧.	លោកស្រី	លី	ជាន់ណា	មន្ត្រី សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក
៨.	កញ្ញាបណ្ឌិត	ហោ	រ័ត្នណា	មន្ត្រី សាកលវិទ្យាល័យភូមិន្ទកសិកម្ម	សមាជិក

គណៈកម្មការបច្ចេកទេសមានតួនាទី និងការកិច្ចដូចខាងក្រោម៖

- រៀបចំសេចក្តីព្រាងក្របខ័ណ្ឌអប់រំអនាគតផល និងគោលការណ៍ណែនាំដាក់ជូនគណៈកម្មការដឹកនាំពិនិត្យ និងផ្តល់យោបល់ដើម្បីគោរពស្នើសុំ ឯកឧត្តមបណ្ឌិតសភាចារ្យឧបនាយករដ្ឋមន្ត្រី រដ្ឋមន្ត្រីក្រសួងអប់រំ យុវជន និងកីឡា ពិនិត្យ និងសម្រេច
- ផ្តល់ការគាំទ្របច្ចេកទេសដល់គ្រឹះស្ថានឧត្តមសិក្សាដើម្បីធ្វើទំនើបកម្មកម្មវិធីអប់រំឱ្យស្របតាមក្របខ័ណ្ឌអប់រំអនាគតផលសម្រាប់ការអប់រំផ្អែកលើលទ្ធផលសម្រាប់ឧត្តមសិក្សាកម្ពុជា

- សមាជិក សមាជិកា ចូលរួមប្រជុំតាមការអញ្ជើញរបស់ឯកឧត្តមប្រធាន។

គ. ក្រុមការងាររលេខាធិការដ្ឋាន

១.	លោកបណ្ឌិត	កៅ	សុវណ្ណសុផល	ប្រធានការិ. នា.គ្រប់គ្រងឧត្តមសិក្សា	ប្រធាន
២.	លោកបណ្ឌិត	ជា	ស៊ីណាត	អនុប្រធានការិ. នា.ស្រាវជ្រាវនិងនវានុវត្តន៍	អនុប្រធាន
៣.	កញ្ញា	ប៊ុនរី	រីនណា	ប្រធានការិ. ន.គ្រប់គ្រងឧត្តមសិក្សា	សមាជិក
៤.	លោកស្រី	ហួយ	សុច័ន្ទ	អនុប្រធានការិ. នា.គ្រប់គ្រងឧត្តមសិក្សា	សមាជិក
៥.	លោក	ជួរ	ចាន់ណារិទ្ធ	មន្ត្រី នា.គ្រប់គ្រងឧត្តមសិក្សា	សមាជិក
៦.	លោក	កក្តី	ចាន់រតនៈ	មន្ត្រី នា.គ្រប់គ្រងឧត្តមសិក្សា	លេខាធិការ
៧.	លោក	សាមឿន	កិត្យា	មន្ត្រី នា.គ្រប់គ្រងឧត្តមសិក្សា	លេខាធិការ
៨.	លោក	គឹម	ឌឿន	មន្ត្រី នា.គ្រប់គ្រងឧត្តមសិក្សា	លេខាធិការ

ក្រុមការងាររលេខាធិការដ្ឋានមានតួនាទី និងភារកិច្ចដូចខាងក្រោម៖

- រៀបចំសេចក្តីព្រាងក្របខ័ណ្ឌការងារ និងឯកសារគាំទ្រ
- រៀបចំ និងសម្របសម្រួលកិច្ចប្រជុំគណៈកម្មការបច្ចេកទេស និងគណៈកម្មការដឹកនាំ
- រៀបចំសិក្ខាសាលាដើម្បីប្រមូលធាតុចូលសម្រាប់សរសេរក្របខ័ណ្ឌអប់រំអនាគតផល និងគោលការណ៍ណែនាំ
- ផ្តល់ការគាំទ្រផ្នែបាលសម្រាប់ដំណើរការរៀបចំក្របខ័ណ្ឌអប់រំអនាគតផល និងគោលការណ៍ណែនាំ
- សមាជិក សមាជិកា ចូលរួមប្រជុំតាមការអញ្ជើញរបស់ឯកឧត្តមប្រធាន។

សមាសភាពគណៈកម្មការដឹកនាំ គណៈកម្មការបច្ចេកទេស និង ក្រុមការងាររលេខាធិការដ្ឋាន ដូចមានរាយនាមខាងលើត្រូវអនុវត្តការងារតាមការចាត់តាំងខាងលើឱ្យមានប្រសិទ្ធភាពខ្ពស់។

ថ្ងៃ ទី ខែ ឆ្នាំរោង ឆស័ក ព.ស.២៥៦៨
រាជធានីភ្នំពេញ ថ្ងៃទី ០៦ ខែសីហា ឆ្នាំ២០២៤

ឧបនាយករដ្ឋមន្ត្រី
រដ្ឋមន្ត្រីក្រសួងអប់រំ យុវជន និងកីឡា

បណ្ឌិតសភាចារ្យ ហង់ជួន ណារ៉ុន

ចម្លងជូន៖
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- អគ្គនាយកដ្ឋានឧត្តមសិក្សា
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ISBN 978-99950-2-506-9

Directorate General of Higher Education