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Direct Assessment Tool of Undergraduate Engineering Programs at University of Selangor (UNISEL)

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Abstract

In this paper, the details of MyOutcomes (MyO) systems as a direct assessment tool at course and program level to assess the students' Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs) attainments was developed. This system was developed and practiced in the Department of Engineering, Faculty of Engineering and Life Sciences (FELS), UNISEL. The PLO is being assessed upon graduation and indicates the achievements of program students in their studies. Since Outcome-Based Education (OBE) practice is getting more attention in Institutions of Higher Learning (IHL), suitable tools are required to support the whole OBE process throughout the planning stage until evaluation stage for quality assessments and ongoing program quality enhancement. Thus, a measurement of attainment of PLOs and CLOs are an important tool which provides a benchmark for visualizing how far an institution has succeeded in delivering what it visualized. This paper provides a method by which the attainment of PLOs and CLOs can be quantified by using a novel MyO system as our OBE measuring engine and some results from MyO implementation were presented. MyO is an excel software application that automatically calculates the student's individual CLOs and PLOs attainment based on their respective course's assessments mark. A CLO or a PLO is said to be achieved if the student's total assessment mark is greater than or equal to a defined Key Performance Indicator (KPI) related to that CLOs or PLOs. All academic staff needs to key in their course marks. The results of MyO system are used by the staff members for the attainment of PLOs, CLOs and for improving the overall teaching learning process.

Keywords: Direct Assessment Tool**,** OBE, CLO, PLO

Introduction

Currently all IHLs were implemented "outcome-based" learning in their curriculum development. The UNISEL has paved the way towards the introduction of an OBE Engineering curriculum in Malaysia. Nowadays, engineering education shifts its focus from the traditional method into the outcome-based method, more detailed assessments of student's learning outcomes are required. OBE is being implemented and become the standard of practice in IHL since 2005. Undergraduate curriculum needs to be transformed into OBE in order to meet the requirements of both the Engineering Accreditation Council (Council, 2012)and the Malaysian Quality Framework introduced by the Malaysian Qualification Agency (Agency, 2010)

OBE refers to an educational system that focuses on what the students are expected to be able to do within the specified period of learning(Mohamad, Tukiran, Hanifa, Ahmad, & Som, 2012). OBE system can be defined as a process that involves an approach to planning, implementing, assessment and evaluating the extent to which achievement objectives and 'outcomes' of a study program can be achieved(Zulfadli, Mokhtar, Puteh, & Anuar, 2015). Outcome-based evaluation, sometimes called outcomes measurement, is a systemic way to determine if a program has achieved its goals. Thus, OBE implementation is very important and one aspect of the approach is measurement of learning outcomes attainment which is called Course Learning Outcomes (CLO) and Program Learning Outcomes (PLO)(Mokhtar, Zulfadli, & Anuar, 2015). The overall accomplishment of OBE requires assessment of Program Education Objectives (PEOs), Program Learning Outcomes (PLOs) and Course Outcomes (CLOs)(Mahesh, 2015).

Each course has its own set of CLOs and PLOs. At the end of each course, the CLOs and PLOs need to be assessed and evaluated to check whether it has been attained or not. A computerized systems(Abidin, Anuar, & Shuaib, 2009) developed to utilize data obtained from students' course assessment marks and to hasten the analysis process. Based on these results, faculty members will then determine if these outcomes are being achieved, and they will utilize the information collected during the assessment process to improve the curriculum of the program.

This paper discusses the tool used for the assessment of CLO and PLO in our department. Direct tools are used for the CLO and PLO assessment. The system was developed using Microsoft excel software. This method is evolved and practiced in the Department of Engineering, FELS since practicing OBE concepts.

Background of Study

The UNISEL in particular fully supports and implements OBE in its engineering programs. Guided by EAC Manual (2012), the FELS crafted its own Program Educational Objectives (PEO) and PLOs to do OBE assessment and Continuous Quality Improvement (CQI) implementation in its engineering programs according to the OBE model shown in Figure 1.

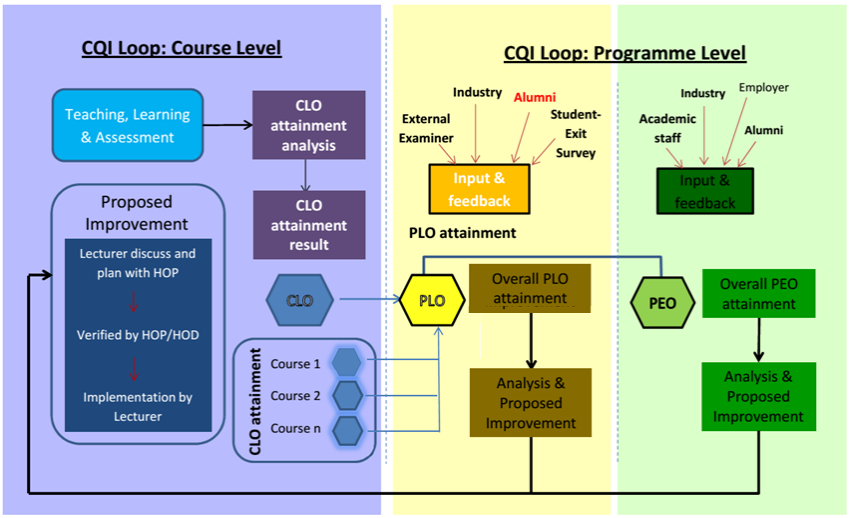


Figure 1. CQI of FELS, Department of Engineering

Program Outcomes are statements which describes what students are expected to know and achieve by the time of graduation. The FELS refers the Program Outcomes (POs) as stated in the EAC manual, as "Program Learning Outcomes (PLOs)". The new

PLOs were formulated based on EAC Manual 2012. The PLOs are formulated based on established PEOs, which were developed according to the attributes suggested by EAC and Malaysian Qualifications Framework (MQF) Domains. The PLOs were carefully formulated to address each of the generic attributes with more concise statement that reflects the Bachelor of Engineering (Hons.) programs. Table 1 lists the current PLOs statements and Table 2 and 3 illustrate the linkages between the new PLOs with EAC attributes and MQF Domains.

Table 1
PLO Statements

Domain	PLOs	Bachelor of Engineering STATEMENT
		At the end of the programme students should be able:
KNOWLEDGE	PLO 1	to apply knowledge of mathematics, science, engineering fundamentals and other related fields to the solution of complex engineering problems
	PLO 2	to Identify, formulate, research literature and analyze complex engineering problems
	PLO 3	to design solutions for complex engineering problems that meet specified needs with appropriate consideration for public health and safety, societal, and environmental considerations
	PLO 4	to conduct investigation into complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
SKILLS	PLO 5	to apply reasonable and practical knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice
	PLO 6	to explain the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
	PLO 7	to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations
	PLO 8	to function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
ATTITUDE	PLO 9	to communicate effectively on complex engineering activities with the engineering community and with society at large
	PLO 10	to demonstrate knowledge of engineering, management and financial principles in multidisciplinary environments
	PLO 11	to demonstrate ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
	PLO 12	to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Table 2
The Linkages between PLOs and EAC Attributes

EAC Program Outcome (EAC-PO)	PLO of B. Eng (Hons.) Mechanical											
	KNOWLEDGE							SKILLS			ATTITUDE	
	1	2	3	4	5	6	7	8	9	10	11	12
Apply knowledge of mathematics, science, engineering fundamentals and engineering specialization to the solution of complex engineering problems	v											
Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;		v										
Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural,societal, and environmental considerations			v									
Conduct investigation into complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions				v								
Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations										v		
Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice					v							
Understand the impact of processional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development						v						
Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice											v	
Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentation, and give and receive clear instructions									v			
Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings								v				
Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.												v
Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments							v					

Table 3
The Linkages between PLOs and MQF Domains

MQF Domain	PLOs of B. En (Hons.) Mechanical											
	PLO1	PLO2	PLO3	PLO	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
Knowledge	v	v	v	v	v	v	v					
Practical Skill										v		
Social Skill and Responsibilities					v	v		v				
Ethics, Professionalism and Humanities											v	
Communication, Leadership and Team Skills								v	v			
Scientific Methods, Critical Thinking and Problem Solving Skills		v										
Lifelong Learning and Information Management												v
Entrepreneurship and Managerial Skills							v					

Course Learning Outcomes (CLO)

CLOs define the qualities attained by the students on completing the particular course on a subject(Mahesh, 2015). The Table 4 shows the list of CLO for a specific course (Engineering Mathematics I).

To measure the attainment of CLO and PLO, EAC has given guide that the CLO should be mapped to PLO. The method of mapping is left to each program owner as long as it can show that the achievement of CLO will contribute to that achievement of PLO.

Table 4
A sample list of Course Learning Outcomes (CLO) for the course 'Engineering Mathematics I'

	Course Outcomes (CLO) for Engineering Mathematics I (KFS1113)
1	Solve complex number operations, conversion in polar form, exponential form and by using De Moivre's theorem.
2	Apply the concept of differentiation and evaluate the differentiation by using several methods.
3	Evaluate indefinite and definite integrals and integrate the given functions by using several methods.
4	Evaluate the beneath curve, volume of revolution and the length of curves.
5	Solve matrices operations, inverse of matrices and apply Cramer's Rule.

Course Level

At the beginning of the semester, students are provided with a Course Information (CI) by the lecturer that guides them on how the course will be delivered throughout the semester. The CI contains the weighted assessment components, CLO-PLO mapping, and assessments-CLO mapping among others. Students' mark was accumulated from the assessments and will use it to measure the students learning outcomes through a MyO system. The detailed report of attainment can be seen in Course Assessment Review Report (CARR). This system will generate the CLO and PLO attainments based on the individual student's CLO and PLO attainments marks. These results will be applied by lecturers to prepare the course review and compared with the previous semester, which is to identify the part that has been improved and need to improve wholly. This complete Continuous Quality Improvement (CQI) process in the course level is depicted in Figure 2.

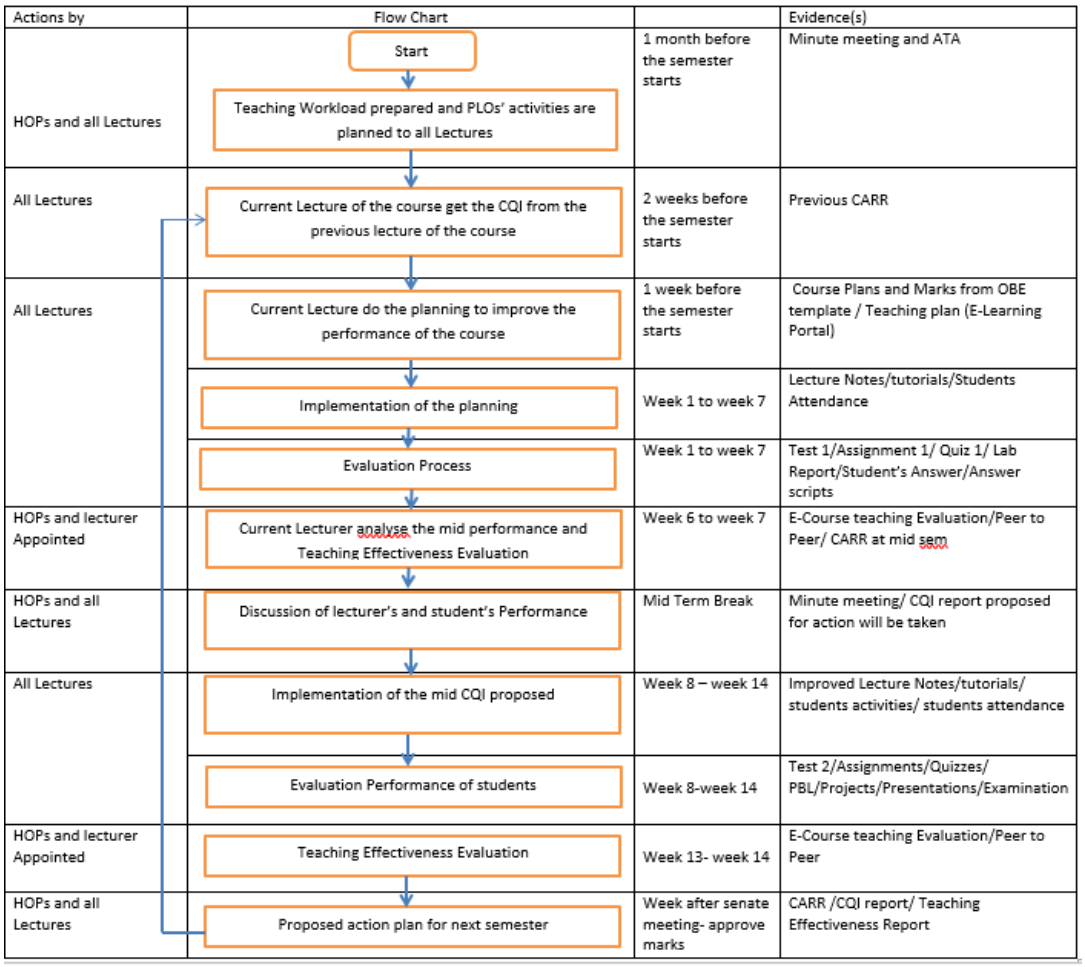


Figure 2. Course Level Process Flow

Purpose of the Study

The purpose of this study was to develop the effectiveness method that is used to analyze or evaluate the attainment of specific learning outcomes which are Course Learning outcomes (CLOs) and Program Learning Outcomes (PLOs) for all courses using MyO system. MyO is an excel software application that automatically calculates the student's individual CLOs and PLOs attainment based on their respective course's assessments mark. The following research questions were formulated in order to achieve the aims of the study.

Research Questions

The research questions for this study are as follow:

1. How do we know if the program was effective?
   As researcher can perceive, learning to measure outcomes is only a first step in the process towards making sure that our programs are having the impact that we desire. However, it is still a crucial step in the process. With first cultivating an evidence-based approach, IHLs can move forward to proper program effectiveness evaluation.

2. What requirements does the system need to fulfill?
   We talk a lot about outcomes, but the truth is that performance measurement doesn't mean anything without the proper assessment and evaluation. The system described in this study need to fulfill these requirements such as identify and document the outcomes, activities, and indicators to be evaluated, and assess the quantity and quality of the program's achievements. The determination of desired outcomes, activities, and indicators should take place during the planning stages of system development.

3. How does the system develop students' achievement in program?
   MyO system was designed to measure students' achievement in the program. This system was developed to assign proper assessments and evaluate the attainment of CLO and PLO students per courses to ensure that students are able to distinguish and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program. Besides that, the outcomes from the system help in monitoring the quality of the program and for continuous quality improvement.

Methodology

This paper will now present the details of CLO and PLO attainments from the course level up to the program level using MyO system. The MyO system was developed using Excel worksheets which automatically calculate the course's CLO and PLO attainments at the end of the semester. The following Figure 3 shows the process of MyO system.

The students' raw marks were used as input, which automatically generates the respective CLO and PLO assessment marks. The outputs the comparative CLO and PLO attainments for the previous and current semester that serves as the basis for CQI plan. MyO results from all courses were then collected and used at the program level to calculate the student's PLO attainments upon graduation. Details of the MyO process flow are shown in Figure 4 to 10 using a MyO file of *Engineering Mathematics I* that the author handled in the January 2016 semester (1/16/34). To start a new assessment of a teaching course, the lecturer should select the program offered either for bachelor of engineering or diploma in engineering program as shown in Figure 4.

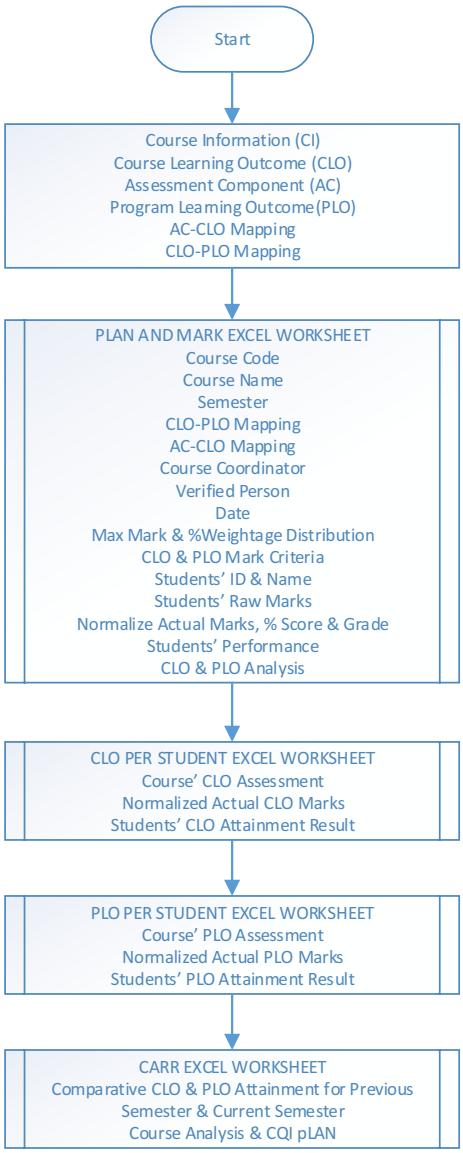


Figure 3. MyO Process Flowchart

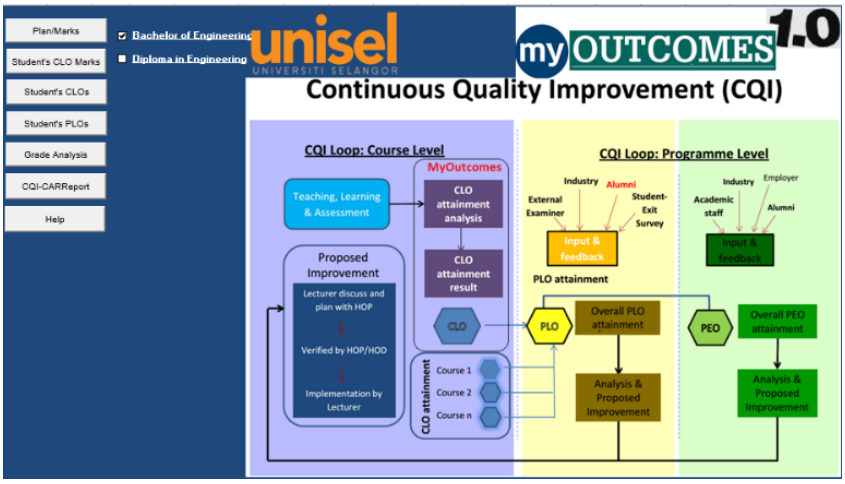
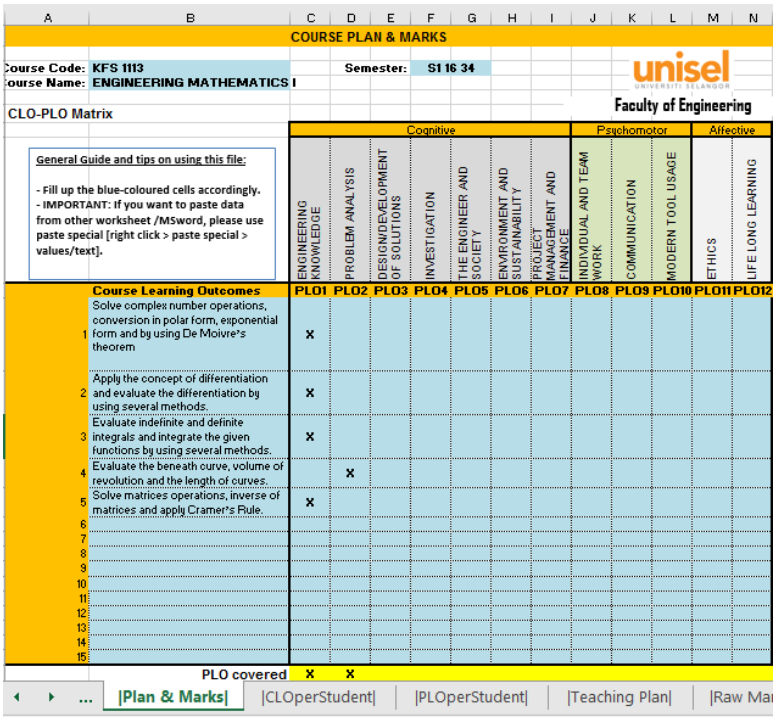


Figure 4. Starting Page of MyO Application



COURSE PLAN & MARKS

Course Code: KFS 1113 Semester: S1 16 34
Course Name: ENGINEERING MATHEMATICS I

unisel UNIVERSITI SELANGOR
Faculty of Engineering

CLO-PLO Matrix

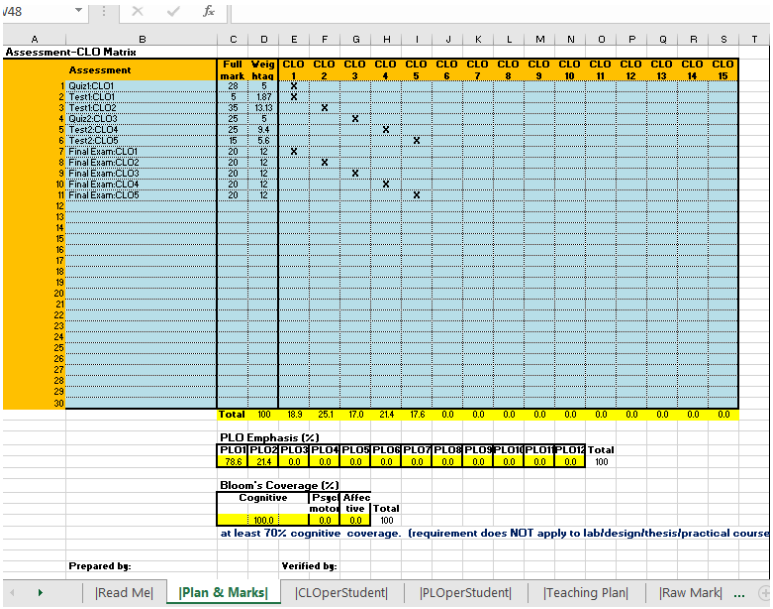
General Guide and tips on using this file:

- Fill up the blue-coloured cells accordingly.
- IMPORTANT: If you want to paste data from other worksheet /MSword, please use paste special [right click > paste special > values/text].

		Cognitive							Psychomotor			Affective	
		ENGINEERING KNOWLEDGE	PROBLEM ANALYSIS	DESIGN/DEVELOPMENT OF SOLUTIONS	INVESTIGATION	THE ENGINEER AND SOCIETY	ENVIRONMENT AND SUSTAINABILITY	PROJECT MANAGEMENT AND FINANCE	INDIVIDUAL AND TEAM WORK	COMMUNICATION	MODERN TOOL USAGE	ETHICS	LIFE LONG LEARNING
	Course Learning Outcomes	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
1	Solve complex number operations, conversion in polar form, exponential form and by using De Moivre's theorem	x											
2	Apply the concept of differentiation and evaluate the differentiation by using several methods.	x											
3	Evaluate indefinite and definite integrals and integrate the given functions by using several methods.	x											
4	Evaluate the beneath curve, volume of revolution and the length of curves.		x										
5	Solve matrices operations, inverse of matrices and apply Cramer's Rule.	x											
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
	PLO covered	x	x										

... |Plan & Marks| |CLOperStudent| |PLOperStudent| |Teaching Plan| |Raw Ma

Figure 5. CLO-PLO Mapping



Assessment-CLO Matrix

	Assessment	Full mark	Weightage	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6	CLO 7	CLO 8	CLO 9	CLO 10	CLO 11	CLO 12	CLO 13	CLO 14	CLO 15
1	Quiz1:CLO1	28	5	x														
2	Test1:CLO1	5	1.87	x														
3	Test1:CLO2	35	13.13		x													
4	Quiz2:CLO3	25	5			x												
5	Test2:CLO4	25	9.4				x											
6	Test2:CLO5	15	5.6					x										
7	Final Exam:CLO1	20	12	x														
8	Final Exam:CLO2	20	12		x													
9	Final Exam:CLO3	20	12			x												
10	Final Exam:CLO4	20	12				x											
11	Final Exam:CLO5	20	12					x										
	Total	100		18.9	25.1	17.0	21.4	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

PLO Emphasis (%)

PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Total
78.8	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100

Bloom's Coverage (%)

Cognitive	Psychomotor	Affective	Total
100.0	0.0	0.0	100

at least 70% cognitive coverage. (requirement does NOT apply to lab/design/thesis/practical course

Prepared by: Verified by:

|Read Me| |Plan & Marks| |CLOperStudent| |PLOperStudent| |Teaching Plan| |Raw Mark| ...

Figure 6. Assessment Component (AC)-CLO Mapping

From the mapping matrix CLOs and PLOs for one course as shown in Figure 5 where PLOs are mapped to one or more CLOs, but only one CLO is mapped to one PLO. Lecturers are given flexibility to plan the mapping based on their preference where each assessment component can be mapped to one or more CLOs and need to enter full mark and weightage percentage distribution for each assessment component based on 100% marks as shown in Figure 6. These assessment marks are automatically generating the total percentage of each CLO mark covered and each PLO emphasis in the course. The CLO and PLO emphasis are generated automatically using equations (1) to (8).
CLOn emphasis:

$$CLOn = \sum AC : CLOn \qquad (1)$$

PLOn emphasis:

$$PLOn = \sum CLOshared : PLOn \qquad (2)$$

According to Figure 6 and using equation (1), CLO1, 2, 3, 4 and 5 are calculated as:

$$\begin{aligned}
CLO1 &= \sum AC : CLO1 \\
&= Quiz1 : CLO1 + Test1 : CLO1 + FinalExam : CLO1 \qquad = 5 + 1.87 + 12 = 18.87\% \\
CLO2 &= \sum AC : CLO2 \\
&= Test1 : CLO2 + FinalExam : CLO2 \qquad = 13.13 + 12 = 25.13\% \\
CLO3 &= \sum AC : CLO3 \\
&= Quiz2 : CLO3 + FinalExam : CLO3 \qquad = 5 + 12 = 17.0\% \\
CLO4 &= \sum AC : CLO4 \\
&= Test2 : CLO4 + FinalExam : CLO4 \qquad = 9.4 + 12 = 21.4\% \\
CLO5 &= \sum AC : CLO5 \\
&= Test2 : CLO5 + FinalExam : CLO5 \qquad = 5.6 + 12 = 17.6\%
\end{aligned}$$

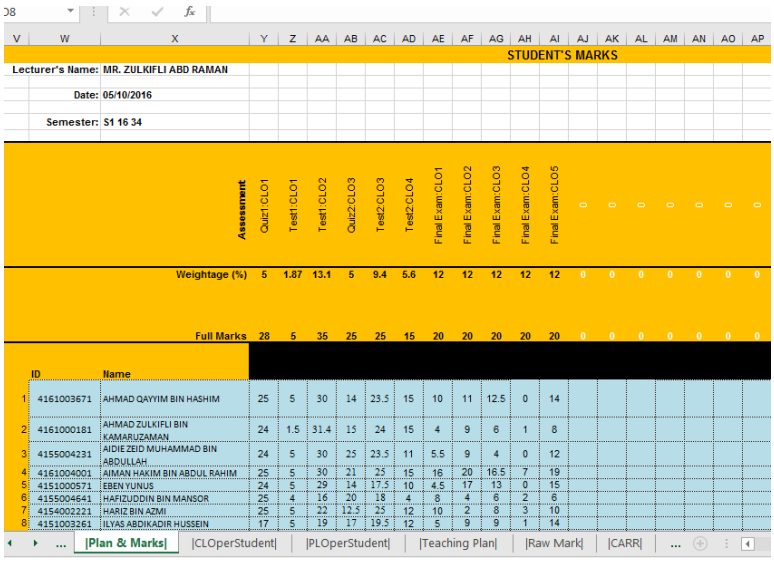
Based on Figure 6, and using equation (2), PLO1 and 2 are calculated as:

$$\begin{aligned}
PLO1 &= \sum CLOshared : PLO1 \\
&= CLO1 + CLO2 + CLO3 + CLO5 \\
&= 18.87 + 25.13 + 17 + 17.6 = 78.6\% \\
PLO2 &= \sum CLOshared : PLO2 \\
&= CLO4 \\
&= 21.4\%
\end{aligned}$$

This result shows CLOs emphasis contributes to PLOs emphasis which is:

$$\begin{aligned}
\sum CLOn &= \sum PLOn \\
&= CLO1 + CLO2 + CLO3 + CLO4 + CLO5 \\
&= PLO1 + PLO2 = 78.6 + 21.4 = 100\%
\end{aligned}$$

After generating the CLO and PLO emphasis, the lecturer is now ready to key-in the students' individual assessment mark. The students' marks are tabulated according to the assessment types by CLOs. Figure 6 shows the individual student's raw marks distributed to respective CLOs with corresponding CLO marks. These marks are then used to calculate the CLO and PLO attainment as shown in Figure 8 to 10.



STUDENT'S MARKS

Lecturer's Name: MR. ZULKIFLI ABD RAMAN

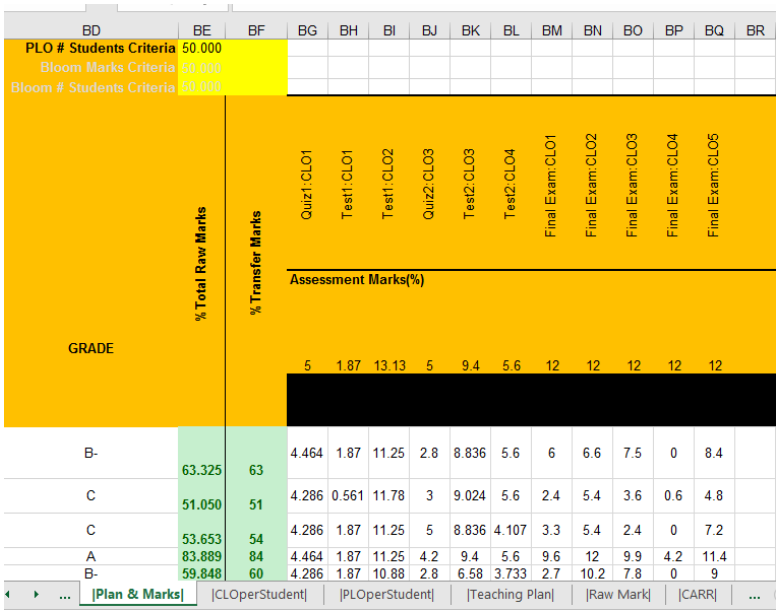
Date: 05/10/2016

Semester: S1 16 34

	Assessment	Quiz1:CLO1	Test1:CLO1	Test1:CLO2	Quiz2:CLO3	Test2:CLO3	Test2:CLO4	Final Exam:CLO1	Final Exam:CLO2	Final Exam:CLO3	Final Exam:CLO4	Final Exam:CLO5	0	0	0	0	0	0	0
	Weightage (%)	5	1.87	13.1	5	9.4	5.6	12	12	12	12	12	0	0	0	0	0	0	0
	Full Marks	28	5	35	25	25	15	20	20	20	20	20	0	0	0	0	0	0	0
	ID	Name																	
1	4161003671	AHMAD QAYYIM BIN HASHIM	25	5	30	14	23.5	15	10	11	12.5	0	14						
2	4161000181	AHMAD ZULKIFLI BIN KAMARUZAMAN	24	1.5	31.4	15	24	15	4	9	6	1	8						
3	4155004231	AIDIE ZEID MUHAMMAD BIN ABDULLAH	24	5	30	25	23.5	11	5.5	9	4	0	12						
4	4161004001	AIMAN HAKIM BIN ABDUL RAHIM	25	5	30	21	25	15	16	20	16.5	7	19						
5	4151000571	EBEN YUNUS	24	5	29	14	17.5	10	4.5	17	13	0	15						
6	4155004641	HAFIZUDDIN BIN MANSOR	25	4	16	20	18	4	8	4	6	2	6						
7	4154002221	HARIZ BIN AZMI	25	5	22	12.5	25	12	10	2	8	3	10						
8	4151003261	ILYAS ABDIKADIR HUSSEIN	17	5	19	17	19.5	12	5	9	9	1	14						

|Plan & Marks| |CLOperStudent| |PLOperStudent| |Teaching Plan| |Raw Mark| |CARR|

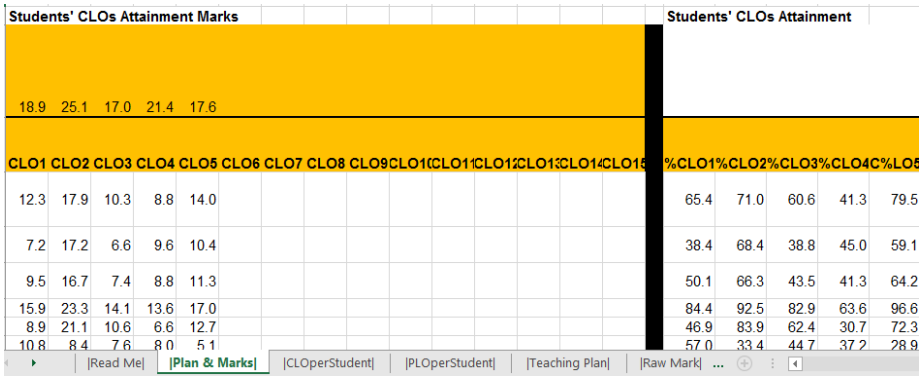
Figure 7. Students' Raw Assessment Marks



	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ
PLO # Students Criteria	50.000												
Bloom Marks Criteria	60.000												
Bloom # Students Criteria	50.000												
GRADE	% Total Raw Marks	% Transfer Marks	Quiz1:CLO1	Test1:CLO1	Test1:CLO2	Quiz2:CLO3	Test2:CLO3	Test2:CLO4	Final Exam:CLO1	Final Exam:CLO2	Final Exam:CLO3	Final Exam:CLO4	Final Exam:CLO5
			Assessment Marks(%)										
			5	1.87	13.13	5	9.4	5.6	12	12	12	12	12
B-	63.325	63	4.464	1.87	11.25	2.8	8.836	5.6	6	6.6	7.5	0	8.4
C	51.050	51	4.286	0.561	11.78	3	9.024	5.6	2.4	5.4	3.6	0.6	4.8
C	53.653	54	4.286	1.87	11.25	5	8.836	4.107	3.3	5.4	2.4	0	7.2
A	83.889	84	4.464	1.87	11.25	4.2	9.4	5.6	9.6	12	9.9	4.2	11.4
B-	59.848	60	4.286	1.87	10.88	2.8	6.58	3.733	2.7	10.2	7.8	0	9

|Plan & Marks| |CLOperStudent| |PLOperStudent| |Teaching Plan| |Raw Mark| |CARR|

Figure 8. Students' CLO Assessment Marks



Students' CLOs Attainment Marks																Students' CLOs Attainment				
18.9	25.1	17.0	21.4	17.6																
CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7	CLO8	CLO9	CLO10	CLO11	CLO12	CLO13	CLO14	CLO15		%CLO1	%CLO2	%CLO3	%CLO4	%CLO5
12.3	17.9	10.3	8.8	14.0												65.4	71.0	60.6	41.3	79.5
7.2	17.2	6.6	9.6	10.4												38.4	68.4	38.8	45.0	59.1
9.5	16.7	7.4	8.8	11.3												50.1	66.3	43.5	41.3	64.2
15.9	23.3	14.1	13.6	17.0												84.4	92.5	82.9	63.6	96.6
8.9	21.1	10.6	6.6	12.7												46.9	83.9	62.4	30.7	72.3
10.8	8.4	7.6	8.0	5.1												57.0	33.4	44.7	37.2	28.9

|Read Me| |Plan & Marks| |CLOperStudent| |PLOperStudent| |Teaching Plan| |Raw Mark|

Figure 9. Students' CLO Attainment

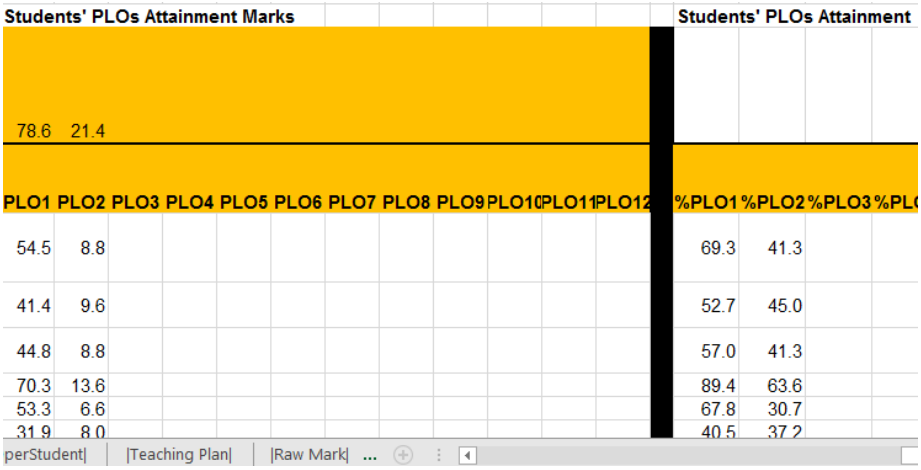


Figure 10. Students' PLO Attainment

After the calculation, the new CLO and PLO mark for each outcome for each student is tabulated in a new table, as shown in Figure 9 and 10. In these figures, the CLO and PLO marks for individual student according to each CLO are presented. The student CLO and PLO assessment marks are generated automatically using equations (3) to (8).

$$CLOn : AssessmentMark = \frac{CLOn : RawAssessmentMark}{CLOn : MaxAssessmentMark} * \%weightage \quad (3)$$

$$CLOnAttainmentMark = \sum CLOn : AsssessmentMark \quad (4)$$

$$CLOn : Attainment = \frac{CLOn : AttainmentMark}{CLOn} * 100\% \quad (5)$$

$$PLOn : AssessmentMark = CLOn : AssessmentMarksharedPLOn \quad (6)$$

$$PLOn : AttainmentMark = \sum CLOn : AttainmentMarksharedPLOn \quad (7)$$

$$PLOnAttainment = \frac{PLOn : AttainmentMark}{PLOn} * 100\% \quad (8)$$

For example, for the student with ID of 4161003671 in Figure 7, CLO1 and PLO1 attainments are calculated as:

$$Quiz1 : CLO1 = \frac{25}{28} * 5\% = 4.46\%$$

$$Test1 : 1CLO1 = \frac{5}{5} * 1.87\% = 1.87\%$$

$$FinalExam : CLO1 = \frac{10}{20} * 12\% = 6\%$$

$$CLO1 : AttainmentMark = Quiz1 : CLO1 + Test1 : CLO1 + FinalExam : CLO1$$

$$CLO1 : AttainmentMark = 4.46 + 1.87 + 6 = 12.33\%$$

$$PLO1 : AttainmentMark = CLO1 : AttainmentMark + CLO2 : AttainmentMark +$$

$$CLO3 : AttainmentMark + CLO5 : AttainmentMark$$

$$PLO1 : AttainmentMark = 12.33 + 17.85 + 10.30 + 14 = 54.48\%$$

$$CLO1Attainment = \frac{12.33}{18.87} * 100\% = 65.34\%$$

$$PLO1Attainment = \frac{54.48}{78.6} * 100\% = 69.31\%$$

Department of Engineering decides the target attainment level for each CLO, PLO

and for each student is set 50% as KPI and passing mark for the programs. A CLO or PLO is said to be attained if at least 50% of the students obtain 50% of their assessment mark related to that CLO or PLO. In the example above, it is shows that student has attained CLO1 and PLO1.

Once the marks are keyed in, the system will automatically calculate the CLO and PLO attainment. The result is shown as graph form as depicted in Figure 11 and 12. The graph shows the percentage of CLO and PLO attainment for previous and present semester that are generated in the course.

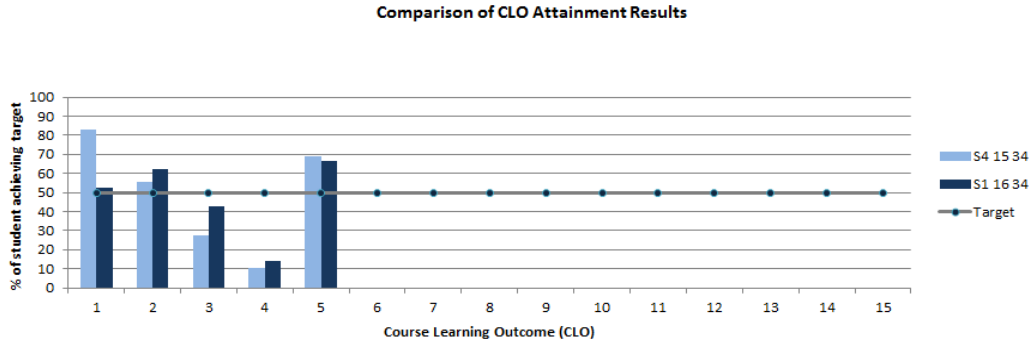


Figure 11. Course's CLO Attainment Results

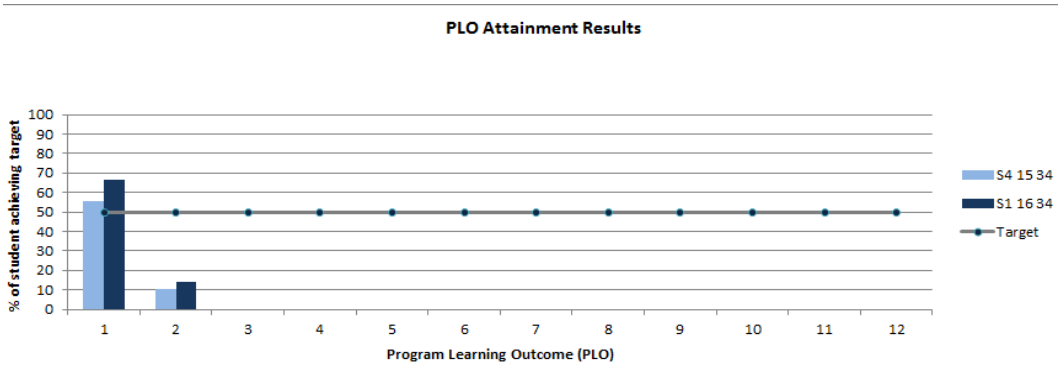
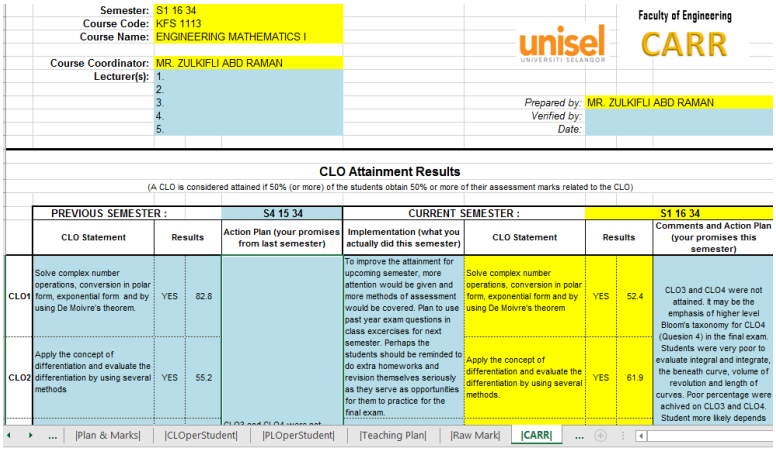


Figure 12. Course's PLO Attainment Results

From the Figure 11, it is found that only CLO1, CLO2 and CLO 5 have scored more than 50% for both semesters. Hence, some of the CLOs attainment levels were improved and there are those that decreased considerably. Besides that, some CLOs although improved did not reached the KPI. Analysis of these results will lead to CQI action plan that can be implemented in the next semester cycle. Similarly, Fig. 12 shows the comparative PLO attainment results for the previous and the current semester. It can be observed that the two PLOs improved from the previous semester to the current semester. PLO2 was not attained, which is a direct result of the CLOs not being attained. Implementation of action plans to improve attainment of all CLOs is required to improve attainment of the related PLOs as well.

The course coordinator or lecturer prepares the CQI action for the next semester by fulfills CQI-CARR Form as shown in Figure 13.



Semester: S1 16 34
Course Code: KFS 1113
Course Name: ENGINEERING MATHEMATICS I
Course Coordinator: MR. ZULKIFLI ABD RAMAN
Lecturer(s): 1.
2.
3.
4.
5.

unisel UNIVERSITI SELANGOR
Faculty of Engineering
CARR

Prepared by: MR. ZULKIFLI ABD RAMAN
Verified by:
Date:

CLO Attainment Results

(A CLO is considered attained if 50% (or more) of the students obtain 50% or more of their assessment marks related to the CLO)

	PREVIOUS SEMESTER :			S4 15 34	CURRENT SEMESTER :			S1 16 34
	CLO Statement	Results		Action Plan (your promises from last semester)	Implementation (what you actually did this semester)	CLO Statement	Results	Comments and Action Plan (your promises this semester)
CLO1	Solve complex number operations, conversion in polar form, exponential form and by using De Moivre's theorem.	YES	82.8		To improve the attainment for upcoming semester, more attention would be given and more methods of assessment would be covered. Plan to use past year exam questions in class excercises for next semester. Perhaps the students should be reminded to do extra homeworks and revision themselves seriously as they serve as opportunities for them to practice for the final exam.	Solve complex number operations, conversion in polar form, exponential form and by using De Moivre's theorem	YES 52.4	CLO3 and CLO4 were not attained, it may be the emphasis of higher level Bloom's taxonomy for CLO4 (Quesion 4) in the final exam. Students were very poor to evaluate integral and integrate, the beneath curve, volume of revolution and length of curves. Poor percentage were achived on CLO3 and CLO4. Student more likely depends
CLO2	Apply the concept of differentiation and evaluate the differentiation by using several methods	YES	55.2			Apply the concept of differentiation and evaluate the differentiation by using several methods.	YES 61.9	

... | Plan & Marks | | CLOperStudent | | PLOperStudent | | Teaching Plan | | Raw Mark | | CARR | ...

Figure 13. CQI-CARR Form

Program Level Assessment

Every semester, the Program Division compiles the PLO attainment data for all courses and analyzes it to obtain the overall level of PLO attainment for the particular semester. All MyO-CARR files from semester 1 to semester 7 were collected. PLO with low attainment will be highlighted during department meeting. Any courses mapped to this PLO will need to revise its delivery and assessment methods. Figure 14 and 15 gives sample of the summary of PLO attainment for Bachelor of Engineering (Hons.) Mechanical for semester 41434 and 11534. From Figure 14 it is seen that all PLOs have been attained. For example, PLO 2 which is the attribute related to ability to solve the complex problem can be improved by increasing discussion time and expose the students with the problem analysis rather than lectures.

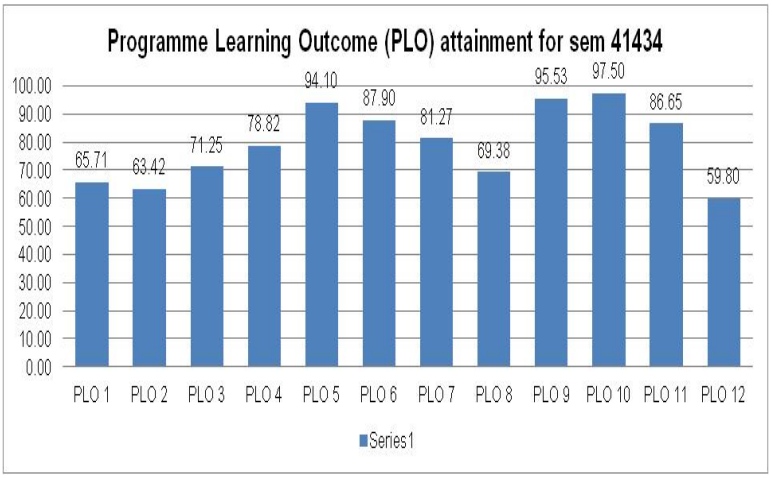


Figure 14. PLOs attainment for semester 41434

This is carried out for each course and is also compiled for each student as shown in a randomly selected student sample seen in Figure 15. Result and analysis of PLOs data are consisting PLOs' achievements of courses per semester. This data is obtained from the MyO-CARR compiled by each lecturer teaching the courses. The compilation is carried out at the end of each semester and action plan is discussed.

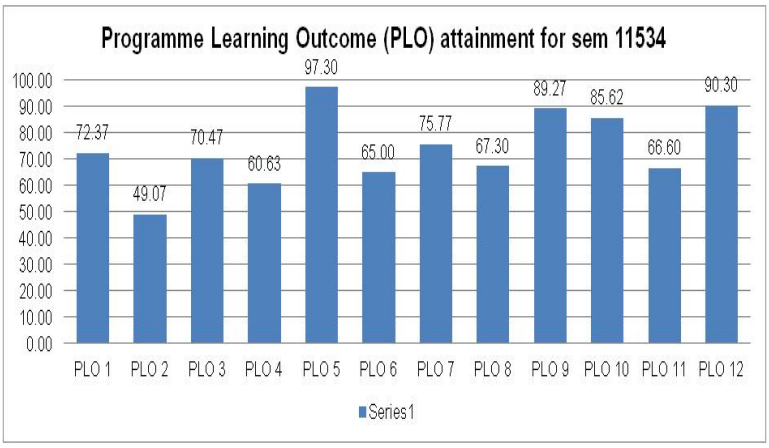


Figure 15. PLOs attainment for sem 11534

In addition, it is also useful to get an alternative insight by calculating PLOs' achievement per student as shown in Figure 16 (randomly selected student as a sample) for a year of 2014. This result is obtained by collecting data of PLOs' achievement of all courses throughout the selected student's study to be carried out annually. It can be seen that overall, the results thus far for both PLOs assessments are encouraging where it shows all PLOs are achieved with (having values greater than 50%).

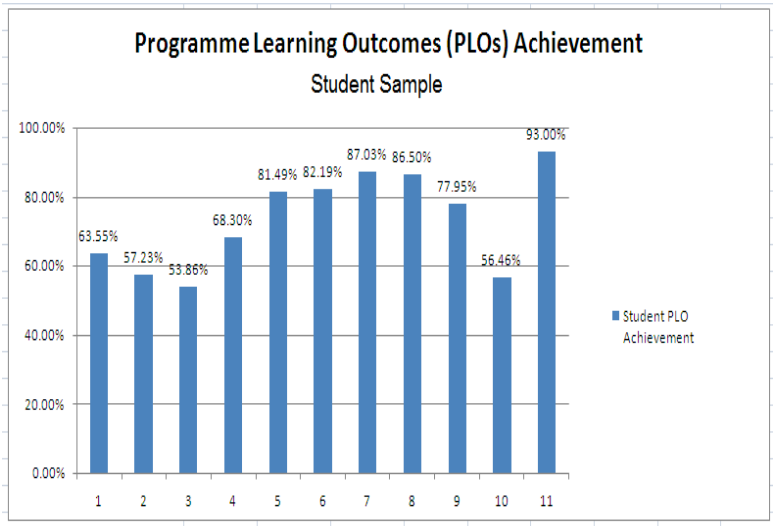


Figure 16. Sample of Student PLOs' Achievement (2014)

The staff member needs to analyze the results of direct assessment gravely for the PLOs which are not attained. This analysis is used to close loop the old PLOs in order to develop the assessment plan and action plan for new PLOs. Performance analysis of CLOs, PLOs, CQI have been conducted manually by the Program Division of the department and the current activities are tedious and time consuming. The CLOs and PLOs assessment and analysis are conducted and recorded based on students' admission and enrolment. Therefore, OBE Online System is proposed to automate the task of Program Division and ease the documentation work for the program.

Conclusion

As a conclusion of this paper, a successful and effective MyO system as a tool for faculty-driven, direct assessment of student attainment of program outcomes that can be

used to ensure quality of education and preparation of engineering program is appropriate and at a good level. MyO system results shows the strong relationship between CLO and PLO in improving the course delivery through regular assessments, monitoring, CQI action planning, and implementation thus ensuring better quality graduates equipped with desired capabilities ready face the complex challenges of their respective field of profession. The analysis of result of PLO attainment will help the lecturer to improve the teaching learning process.

However, MyO system need to review and improve in a various aspect such as automatically calculate PLO attainment at the program level and online database management system to store all MyO results from all courses to generate PLO attainment for each of student, cohort and semester in the database. As whole, MyO system was found to be an essential tool which can be for continuous quality improvement.

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