

Resourceful Microsoft Excel-Based Course Learning Outcomes Assessment Link with Question Banks

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Abstract: This paper presents a resourceful Microsoft Excel-based assessment system that applies question banks for all assignments to assess student learning outcomes according to the weekly schedule of the course. The assessment system is feedbacks the assessment results to the instructor and students for essential improvements for both teaching and learning. A detailed method is described to conduct such assessments based on the weekly distribution of the course material related to its syllabus. Each week course instructor selects assignment from the available bank of questions and aligns each question and its grade percentage to each course learning outcomes to measure student learning outcomes. The method uses the Excel Program to randomly select assignment questions (Test, Exam, Project, Homework) related to the course material taught during the specified week or weeks from question banks. The question banks can be modified regularly by the instructor by adding new questions and aligning them to the related course learning outcomes for each week. The Excel software automatically combines the assessment results from all questions for each assignment to reveal the level of student achievement of course learning outcomes. This combination of formative and summative assessment allows the instructor to continuously revisits and stress on those topics in which students perform unsatisfactorily to assure that student learning outcomes are achieved by the conclusion of the course. The results can then be utilized to close the learning and assessment loop, by incorporating the necessary modifications to the course or courses in the curriculum and start a continuous improvement cycle. The results of the current assessment system are applied to selected electrical engineering courses is rather encouraging. Specially, mechatronics bachelor level courses were assessed using the current method and the outcomes of the assessment process are presented in this paper.

Keywords: Learning Outcomes, Assessment, Question Banks, Microsoft Excel program.

1. INTRODUCTION

Learning outcomes provide an opportunity for programs to effectively review and enhance the alignment between the planned, delivered and experienced curriculum. A comprehensive approach to learning outcomes assessment ensures that decisions related to change are informed by data collected from multiple sources. Recommended methods include multi-stakeholder questionnaires, focus groups and Strength, Weaknesses, Opportunities and Threats (SWOT) analysis, curriculum mapping, curriculum- embedded assessment, and reviews of both scholarly literatures and of analogous programs (Bath et al., 2004). Learning

outcomes approach to education clearly specifies what students are expected to learn and arranges the curriculum such that these intended outcomes are achieved (Harden, 2007a). Learning outcomes provide the base for an effectively aligned and integrated curriculum, where instructional activities and assessment strategies are explicitly linked to course-specific and degree-level learning outcomes, which are tied to institutional and provincially-defined graduate degree level expectations (see Figure 1).

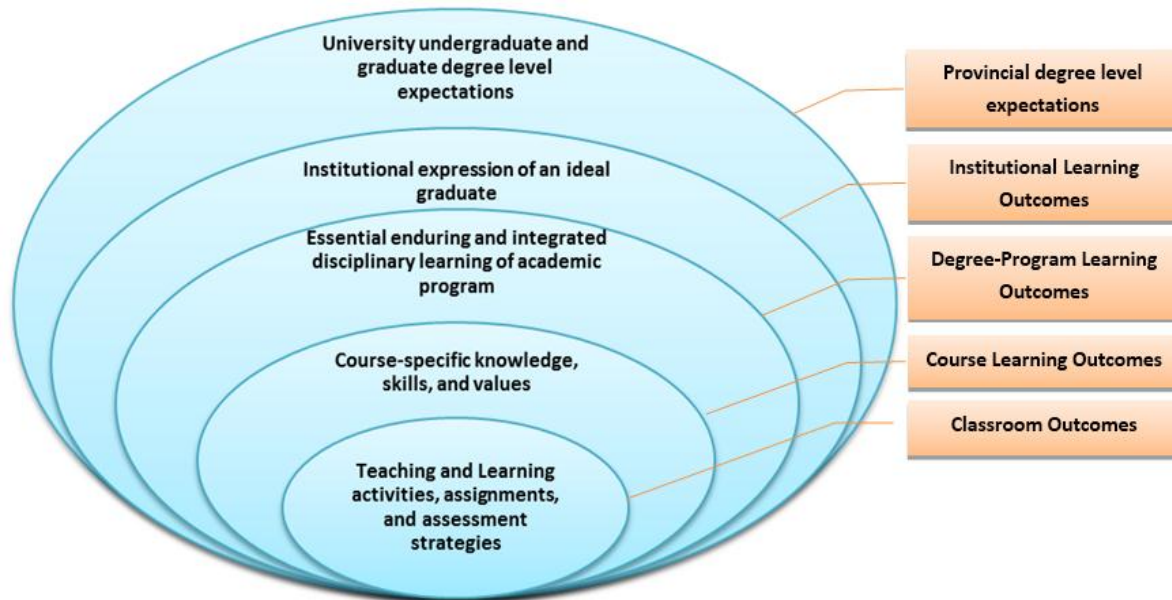


Figure 1 Graphic Representation of Outcomes-based Curriculum Alignment, from Degree Level Expectations to Course-specific Activities

Assessing and evincing learning outcomes are inherently complex tasks that are best approached through a comprehensive process, involving multiple methods and stakeholders (Green et al., 2009). When implemented effectively, learning outcomes assessment can provide evidence of student learning and progression, and prioritize recommendations for continuous curriculum improvement (Cummings et al., 2008).

(Noaman, 2017) presents using an Microsoft Excel program to enable the faculty member in order to measure achievement of the program outcomes (PILOs) using course intended outcomes (CILOs). The faculty member distributes the CILOs into knowledge and understanding, subject-specific skills, thinking skills, general and transferable skills, and attribute based on blooms taxonomy. The faculty assesses the CILOs continuously during the course duration based on the course plan; while the PILOs are measured by mapping the CILOs to assess the PILOs. So it is possible to design a new assessment system for measuring the learning outcomes of any university program by adapting the proposed program to be matched the assessment criterion of that university.

A novel method for measuring achievements of course and program outcomes based on the course plan using the Microsoft Excel program was presented. The course instructor distributes the course intended learning outcomes(CILO's) (knowledge and understanding, subject-specific skills, thinking skills, and general and transferable skills) expected to be measured during the course period each week. Design of an appropriate Course Intended Learning Outcomes to map with the Program Intended Learning Outcomes (PILOs) is implemented. From the course specification, the course syllabus is distributed into different weeks to cover different CILOs, and the examination questions and their grade for each week in a course syllabus at each examination period is defined. The course CILOs achievements

were measured automatically, and consequently, the program outcomes achievements will be also measured. The novelty of this assessment method is to guide the faculty to cover all the course material and presents the distribution of the CILOs through course specification in a good manner in order to satisfy all CILOs and hence help to satisfy the program intended outcomes. So that it can be considered as rigid and accurate assessment method if faculty distributes CILOs percentage per each week in a correct manner (Noaman and Taj, 2018). In this paper, a resourceful Microsoft Excel-Based assessment System that applies question banks for all assignments to assess student learning outcomes according to the weekly schedule of the course and feedback the assessment results to instructors and students for essential improvements on teaching and learning is presented.

2. ASSESSMENT IN HIGHER EDUCATION

Assessment methods are the strategies, techniques, tools, and instruments for collecting information to determine the extent to which students demonstrate desired learning outcomes. The purpose of continuous assessment is that the instructor can continuously assess student's learning outcomes to plan redesign the teaching in accordance with the needs of the students. It provides diagnostic information on the strengths and weaknesses of the students' learning. It also provides feedback to the instructor and program managers to modify curriculum to satisfy program intended outcomes. It facilitates instructors in a grouping of students for learning through various activities, provides criteria of grading and promoting students. It decides the teacher-training method for a program, faculty or staff (Mohammad et al., 2017).

Assessment of learning is not one-time movement, it is a progressing process. It includes the procedure of checking on, reflecting and modifying the learning techniques in an arranged and cautious way. When the assessment is carried out in the classroom in an ongoing or continual way by the instructor it is called continuous or formative assessment (Prouty & George, 2003). In this process, observations are made time to time to collect data to determine the level of students' knowledge, understanding and performance. It is done by giving particular tasks to students based on their previous achievement in the classroom. The teacher observes the activities of students to decide about the level of their performance in class. It also helps them to find out what the learners have learned. Continuous assessment is part and parcel of the instructional process that has to be taken as a key tool in educational quality assurance endeavor (Abejehu, 2016).

The assessment has a powerful effect on what students do and how they do it. Instructors often plan the curriculum for a course, then devise the teaching and learning activities, and then the assessment. When students approach a course they first look at how it is assessed, they then decide on the learning activities they need to engage with in order to meet the assessment requirements as shown in figure 2. Assessment is thus, for most students, a 'lever' which determines how and what they will learn in a course.

Priorities for Instructors:



Priorities for students:

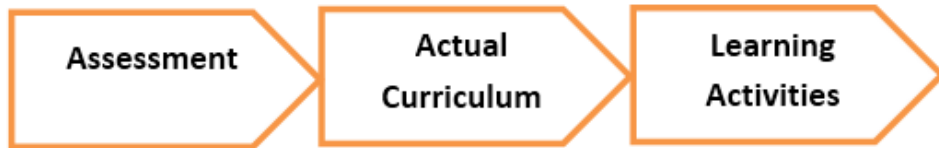


Figure 2 Instructors and Student Priorities

If, however, a course curriculum is designed in such a way that when students work towards meeting the assessment requirements they are in fact achieving the purposes and outcomes of the course then assessment as a ‘lever’ has a valid educational purpose. In short, if the ‘planned’ curriculum and the ‘actual’ curriculum are the same, then students will engage in the desired learning activities. The course purpose, outcomes, teaching methods, assessment methods (approaches and criteria) should all be aligned to ensure that the desired learning is achieved. So, the assessment methods will be designed in such a way that students will be guided into the kind of learning the lecturer wants in order to meet the course outcomes (Lynn Quinn, 2015).

3. LEARNING OUTCOMES ASSESSMENT BASED ON QUESTION BANKS

Learning outcomes assessment based on question banks implementation using the Microsoft Excel program is introduced in this paper. This program applied to university having examinations system with three periods of examination considered as summative examinations, namely test 1, test 2, and final examination. The course period can be considered as 14 weeks, where test 1, test 2, and final examination done at week5, week9, and week 14 respectively. The Microsoft Excel program consists of several sheets such as:

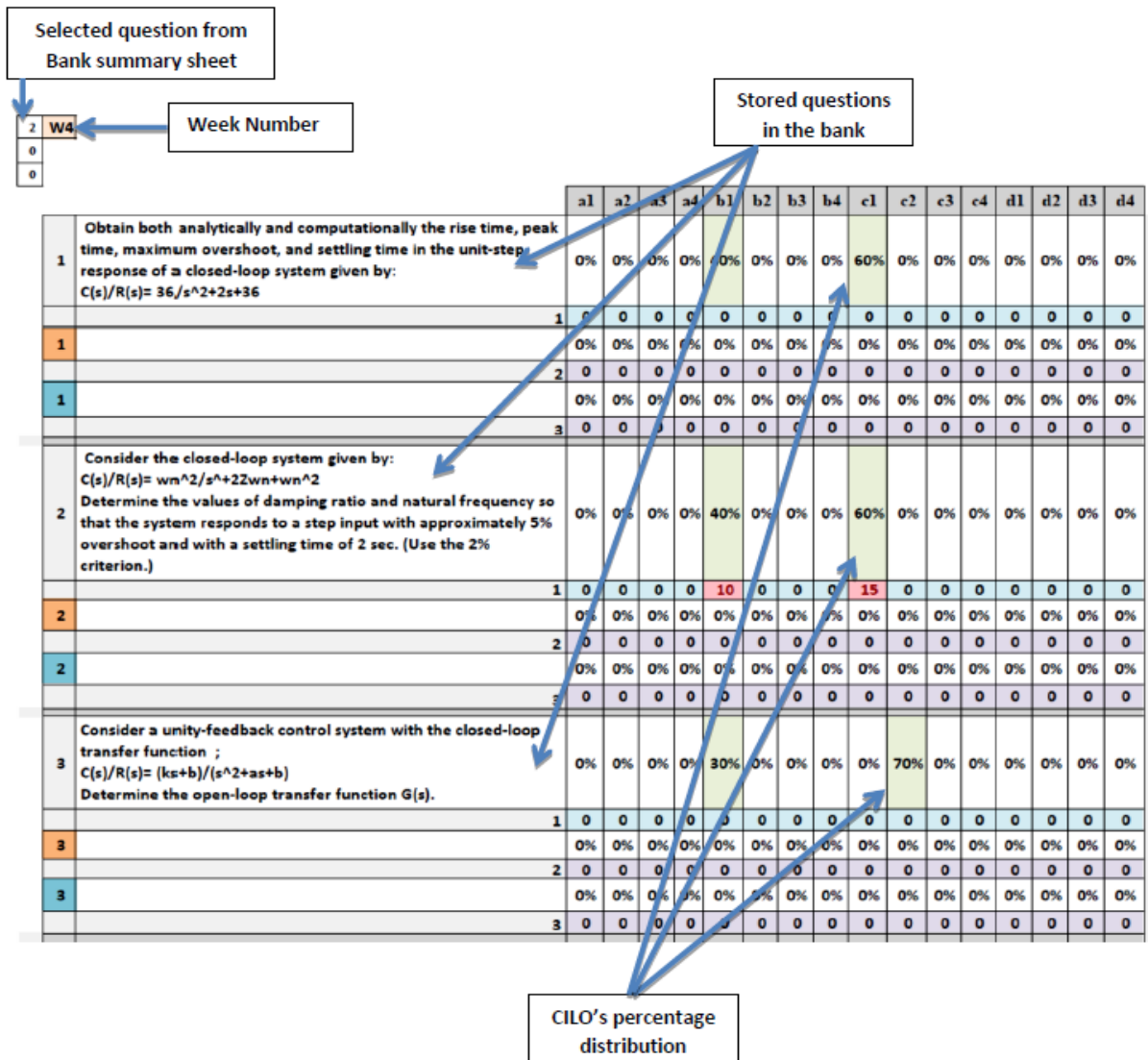


Fig. 3 Sample of Week Questions Bank

- a. **Questions bank:** There are three sheets for test 1, test 2, final examination, and final laboratory examination for which the course instructor store different questions with respect to each week of the course plan. The question bank for each week includes ten questions; each question has three sub-questions, a total of thirty questions per each week of question bank. The course instructor stores the question with its CILO's percentage distribution to be measured according to the course plan for each week the topics. Sample of week 4 questions bank of final exam are shown in figure 3.
- b. **Bank summary:** Examples of the questions stored in the bank for each examination are presented for test 1 bank, test2 bank, final exam bank, and final laboratory bank are shown in figures 4 to 6. Using these sheets course instructor selects the number of the question for the specified examination period. The narrative of the question with its CILO's percentage distribution will a appear in the examination questions paper sheet for the selected week related to what stored in question bank sheet according to the weekly topic.

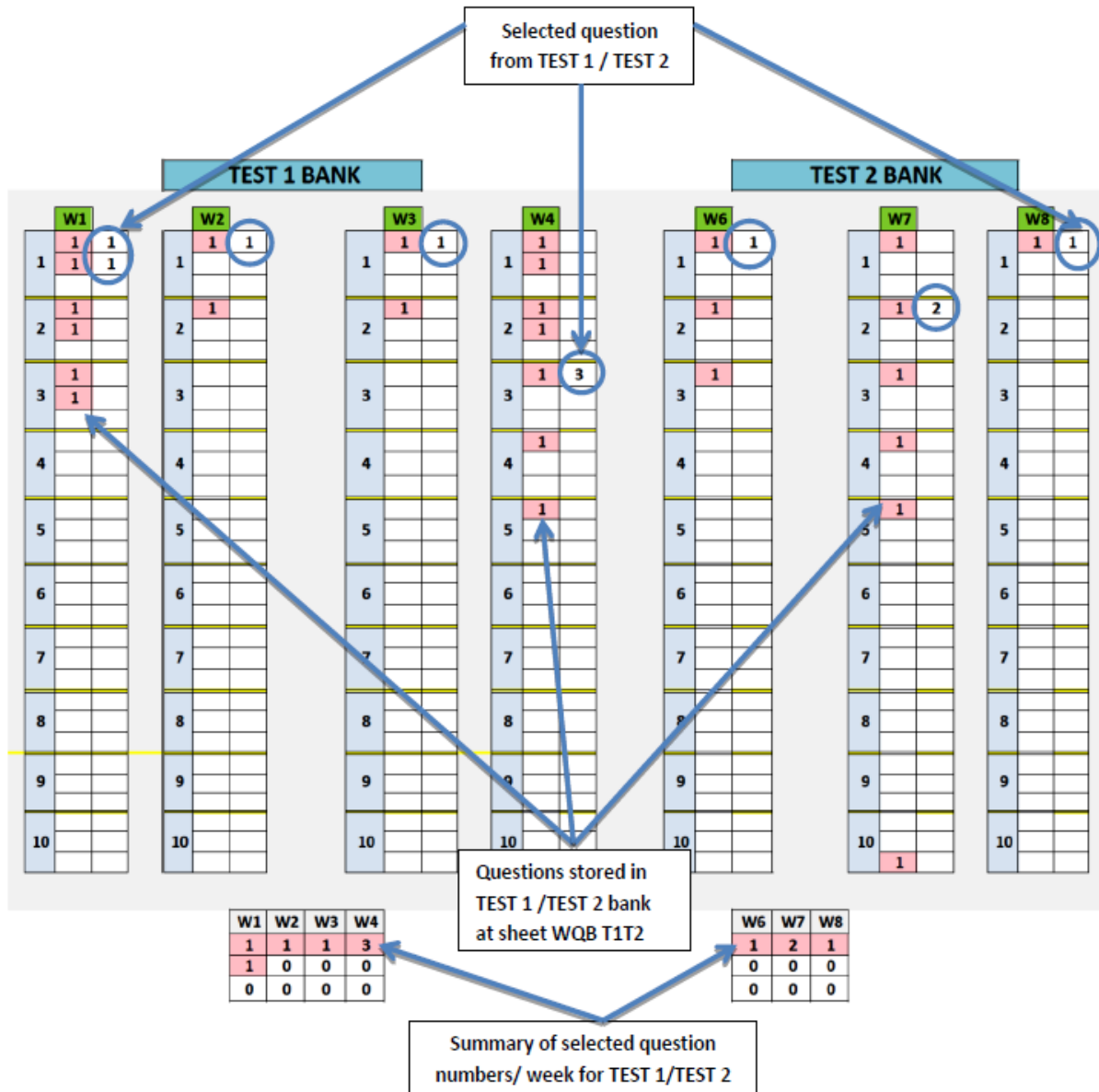


Fig. 4 Bank Summary for Test 1/ test 2 Exam

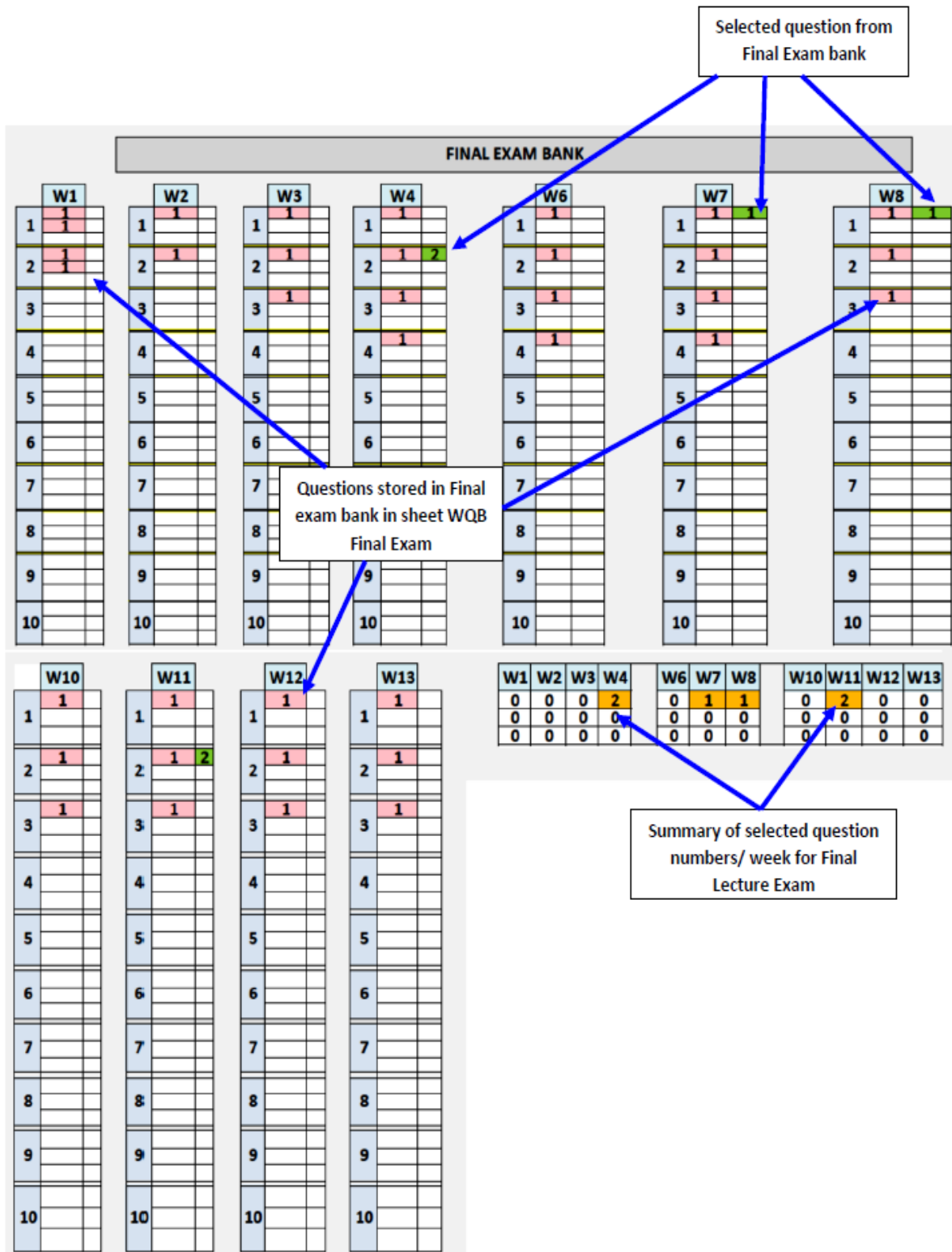


Fig. 5 Bank Summary for Final Lecture Exam

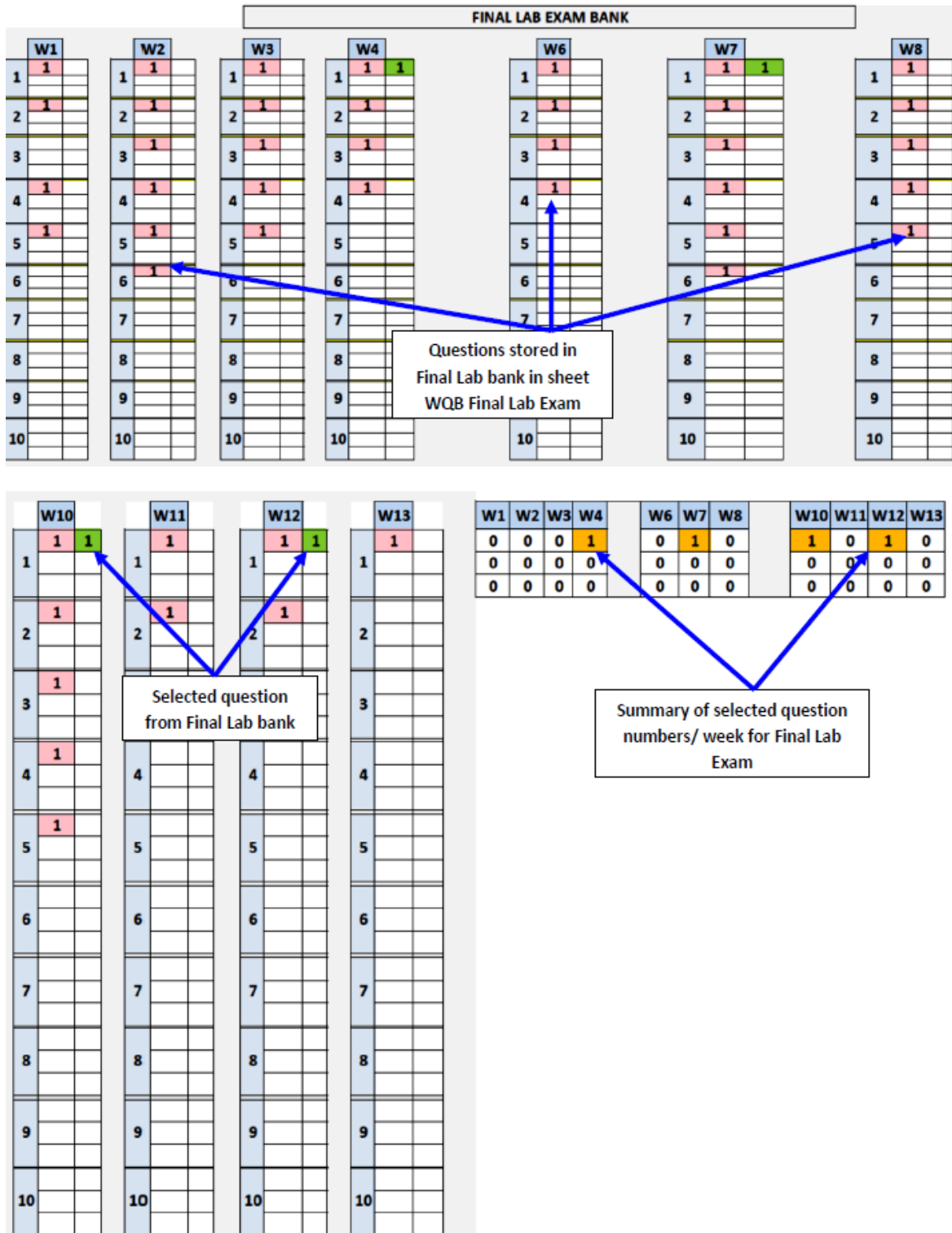


Fig. 6 Bank Summary for Final Lab Exam

c. **Examination questions paper:** These sheets considered as the examination paper which presents the selected questions from the bank summary sheets. It related to test 1 examination, test 2 examination, final examination, and final laboratory examination. The course instructor who prepares the examination, distributes the grade for each one of these selected questions and therefore their percentage CILO's distribution that is

determined through the bank question sheet will appear in CILO's weeks summary for each examination period. A sample of test 2 examination is shown in figure 7.

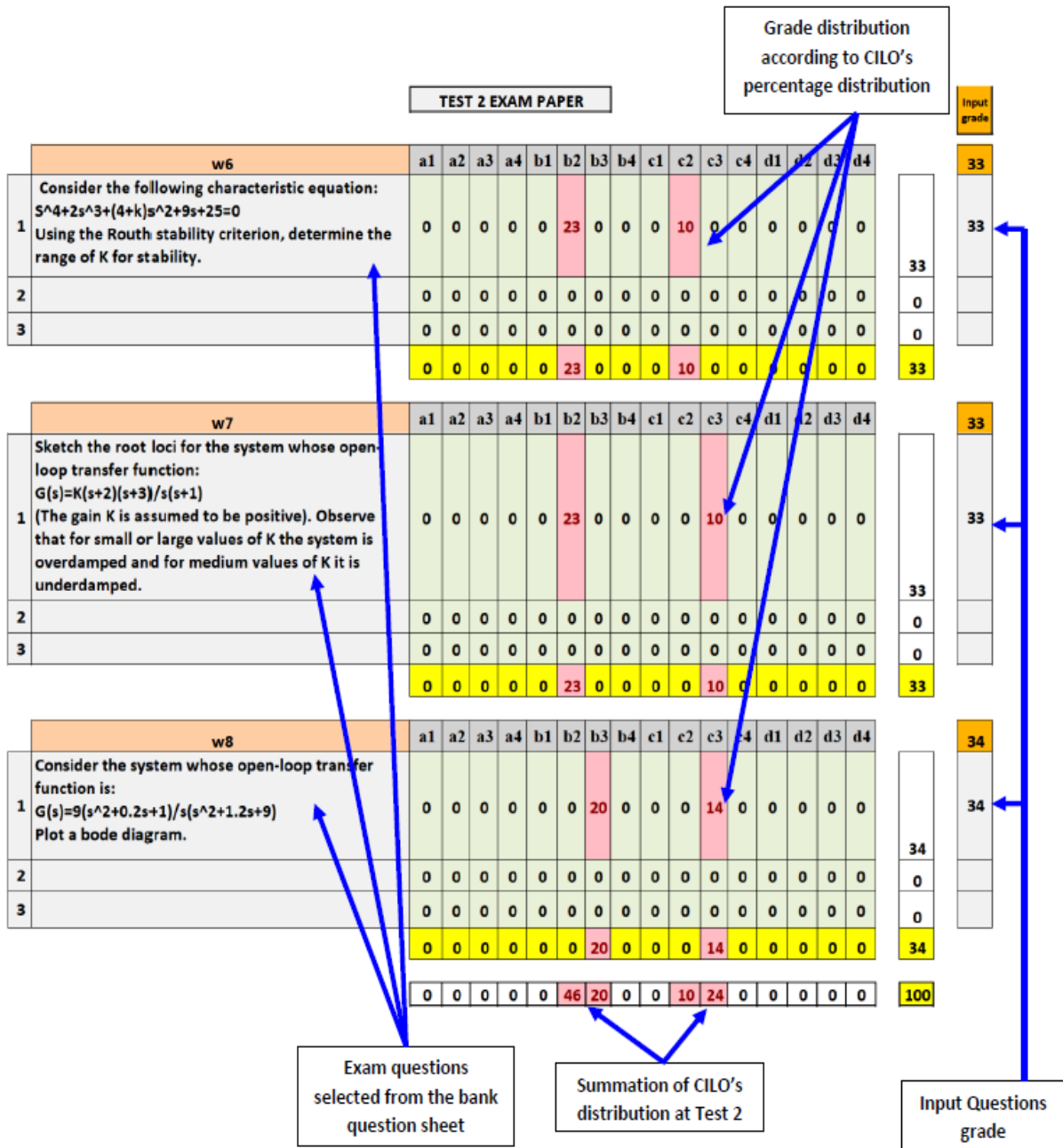


Fig. 7 Examination Paper for Test 2

d. Student's achievements: The student's performance in the summative examination periods (test 1 exam, test 2 exam, final lecture exam, and final lab exam) and formative activities (homework and assignments, lab reports, and project) can be monitored through these sheets. The course instructor will input the student's achievement for each question in the examination periods and students' activities. Therefore, the percentage CILO's achievement of the students in the course in each examination and other activities can be obtained as shown in table 1. Based on these achievement inputs, a percentage of failed students, i.e., students who did not pass

50% in the examination in each CILO for each question at the examination period can be calculated automatically. Figure 8 and figure 9 show a student's achievements and the failed student in the CILO's question and its percentage achievements in one question of final examination respectively.

Table 1: Students achievements through course activities

CILO'S	ACHIEVEMENTS ACTIVITIES						
	TEST 1	TEST 2	FINAL EXAM	FINAL LAB EXAM	ASSIGNMENTS	LAB REPORT	PROJECT/CASE STUDIES
a1	58.50%					73.44%	64.17%
a2	66.00%					70.00%	
a3			58.33%			69.06%	
a4			81.25%				
b1	63.75%		53.75%		76.61%	72.71%	
b2	61.07%	60.47%	63.13%	62.50%	76.98%	65.83%	63.75%
b3		63.73%	78.75%	48.33%	67.81%	65.63%	
b4			59.38%	60.83%			
c1	60.00%		61.25%		65.42%	68.13%	66.67%
c2	62.50%	68.18%		65.00%	73.13%	68.75%	60.00%
c3		64.10%	57.50%	48.33%	80.63%	65.63%	
c4			54.38%	53.33%	65.63%		
d1				63.33%		67.71%	75.31%
d2				64.58%		68.96%	68.75%
d3				54.58%		68.75%	73.13%
d4				59.38%		72.29%	

Table 2: Students CILO Achievements through Test 1 and Test 2 at Each Exam Question

CILO'S	TEST 1 EXAM QUESTIONS				TEST 2 EXAM QUESTIONS		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3
a1	58.37%						
a2		60.00%	75.00%				
a3							
a4							
b1		67.50%	58.50%				
b2				61.07%	61.96%	58.98%	
b3							63.73%
b4							
c1			60.00%				
c2				62.50%	68.18%		
c3						56.19%	69.85%
c4							
d1							
d2							
d3							
d4							

Table 3: Students CILO Achievements through Final Exam and Final Lab Exam at Each Exam Question

CILO'S	FINAL EXAM QUESTIONS				FINAL LAB EXAM QUESTIONS			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
a1								
a2								
a3			58.33%					
a4				81.25%				
b1	53.75%							
b2		63.13%			62.50%			
b3			78.75%				48.33%	
b4				59.38%				60.83%
c1	61.25%							
c2						65.00%		
c3		60.42%	51.67%				48.33%	
c4				54.38%				53.33%
d1					70.00%	53.75%	65.00%	67.50%
d2					61.25%	66.25%	67.50%	65.00%
d3					57.50%	50.00%	57.50%	55.00%
d4					60.00%	57.50%	52.50%	67.50%

- e. **Percentage achievements for each question:** These sheets give the percentage achievements of the students in each question for each examination periods automatically as shown in table 2 and 3.

LAB/WITHOUT LAB		Selection of course with lab										Course grade distribution without Lab					Course grade distribution with Lab				
1		TEST 1		TEST 2		ASSIGNMENT/HOME WORK		PROJECT/CASE STUDY		LAB REPORT		FINAL LAB EXAM		FINAL EXAM		TOTAL GRADE					
		15%	10%	20%	10%	10%	10%	20%	10%	10%	10%	20%	10%	35%	100%						
		Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%						
STUDENT ID		100	100	100	100	100	100	100	100	100	100	100	100	100	100						
1	BH13500202	59	59	65	65	77.67	77.67	74	74	71.33	71.33	63	63.00	65	65	66.80					
2	BH15501024	61	61	51	51	76.67	76.67	74	74	66.33	66.33	52	52.00	59	59	61.00					
3	BH14500315	70	70	77	77	79.00	79.00	65	65	62.67	62.67	51	51.00	56	56	62.37					
4	BH15500044	73	73	61	61	76.67	76.67	65	65	68.67	68.67	47	47.00	78	78	67.23					
5	BH15500565	45	45	50	50	66.67	66.67	61	61	67.33	67.33	47	47.00	48	48	52.80					
6	BH16500480	66	66	75	75	74.67	74.67	54	54	70.33	70.33	62	62.00	51	51	61.70					
7	BH14500889	79	79	80	80	74.00	74.00	77	77	75.67	75.67	78	78.00	88	88	80.57					
8	BH15500411	58	58	72	72	74.00	74.00	57	57	71.00	71.00	65	65.00	65	65	65.70					
9	BH16500356	72	72	74	74	77.33	77.33	79	79	71.33	71.33	74	74.00	71	71	74.07					
10	BH16500357	50	50	43	43	82.67	82.67	66	66	74.33	74.33	56	56.00	50	50	57.80					
11	BH14501070	48	48	41	41	51.33	51.33	61	61	64.67	64.67	47	47.00	41	41	48.30					
12	BH15501031	53	53	65	65	85.00	85.00	69	69	71.67	71.67	59	59.00	56	56	62.97					
13	BH16500106	63	63	67	67	63.67	63.67	83	83	68.67	68.67	64	64.00	72	72	68.93					
14	BH14500181	65	65	74	74	59.33	59.33	65	65	73.00	73.00	57	57.00	59	59	62.73					
15	BH16500774	67	67	52	52	65.67	65.67	65	65	65.67	65.67	51	51.00	66	66	61.53					
16	BH14500906	61	61	57	57	73.67	73.67	64	64	63.00	63.00	66	66.00	57	57	65.87					
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					

LAB/WITHOUT LAB		Selection of course without lab										Course grade distribution without Lab					Course grade distribution with Lab				
0		TEST 1		TEST 2		ASSIGNMENT/HOME WORK		PROJECT/CASE STUDY		LAB REPORT		FINAL LAB EXAM		FINAL EXAM		TOTAL GRADE					
		15%	10%	20%	10%	10%	10%	20%	10%	10%	10%	20%	10%	35%	100%						
		Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%	Type Max Marks below	100%						
STUDENT ID		100	100	100	100	100	100	100	100	100	100	100	100	100	100						
1	BH13500202	59	59	65	65	77.67	77.67	74	74					65	65	67.17					
2	BH15501024	61	61	51	51	76.67	76.67	74	74					59	59	62.47					
3	BH14500315	70	70	77	77	79.00	79.00	65	65					56	56	66.40					
4	BH15500044	73	73	61	61	76.67	76.67	65	65					78	78	71.12					
5	BH15500565	45	45	50	50	66.67	66.67	61	61					48	48	52.42					
6	BH16500480	66	66	75	75	74.67	74.67	54	54					51	51	61.02					
7	BH14500889	79	79	80	80	74.00	74.00	77	77					88	88	81.45					
8	BH15500411	58	58	72	72	74.00	74.00	57	57					65	65	64.65					
9	BH16500356	72	72	74	74	77.33	77.33	79	79					73	73	74.68					
10	BH16500357	50	50	43	43	82.67	82.67	66	66					50	50	55.07					
11	BH14501070	48	48	41	41	51.33	51.33	61	61					41	41	47.08					
12	BH15501031	53	53	65	65	85.00	85.00	69	69					56	56	62.85					
13	BH16500106	63	63	67	67	63.67	63.67	83	83					72	72	71.02					
14	BH14500181	65	65	74	74	59.33	59.33	65	65					59	59	64.13					
15	BH16500774	67	67	52	52	65.67	65.67	65	65					66	66	63.12					
16	BH14500906	61	61	57	57	73.67	73.67	64	64					57	57	60.67					
17	0	0	0	0	0	0	0	0	0					0	0	0					
18	0	0	0	0	0	0	0	0	0					0	0	0					
19	0	0	0	0	0	0	0	0	0					0	0	0					
20	0	0	0	0	0	0	0	0	0					0	0	0					
21	0	0	0	0	0	0	0	0	0					0	0	0					
22	0	0	0	0	0	0	0	0	0					0	0	0					
23	0	0	0	0	0	0	0	0	0					0	0	0					
24	0	0	0	0	0	0	0	0	0					0	0	0					
25	0	0	0	0	0	0	0	0	0					0	0	0					

Fig. 10 Students Grades in all Course Examinations and Activities for Course with Lab/without Lab

f. **Grade sheet:** Summary of the student grades in all course examinations and activities appears in this sheet as shown in figure 10.

4. DISCUSSION OF RESULTS

The Current program applied to control engineering course of one of the AMAIUB program where 16 students were enrolled. The first step to apply the software is to store each question with its percentage of learning skills to be measured by the question related to the specified week topic and for all weeks in all examination period. Depending on the examination period course instructor select the number of questions for each examination period from bank question sheets. The selection of questions according to the examination period for test 1 and test 2 are shown in figure 4 for weeks (w1 to w4) and (w6 to w8) respectively. The selection of questions for the final lecture examination and the final laboratory examination for weeks (w1 to w4), (w6 to w8), and (w10 to w13) are shown in figure 5 and 6. In test 1 exam, the selected questions from weeks are w1-1, w1-2 for Q1, w2-1 for Q2, w3-1 for Q3, and w4-3 for Q4. For test 2 exam the selected questions from weeks are w6-1 for Q1, w7-2 for Q2, and w8-1 for Q3. In the final exam the questions w4-2 for Q1, w7-1 for Q2, w8-1 for Q3, and w11-2 for Q4 are selected. The selected questions in the final lab exam are w4-1 for Q1, w7-1 for Q2, w10-1 for Q3, and w12-1 for Q4 as shown in figures 4 to 6.

After the course instructor selects his questions as mentioned before, the exam questions with its percentage learning skills will appear in the examination questions paper sheet, therefore, at that time the instructor specifies the grades for each question. Each selected question will have a grade distribution determined automatically based on the specified CILO percentage distribution stored previously in the bank question sheet.

To start the assessment process, student's achievements in each examination period (test 1, test 2, final exam, and final lab) are displayed in the student's achievements sheets. Table 1 illustrates student's CILO's achievements through all course activities (test 1, test 2, final exam, final lab exam, assignment, lab report, and project). While, table 2 and table 3 represents the achievements for each question in all examination period. Finally, the student's grades achievements in all examination periods for course with lab or without lab are presented in grad sheet as shown in figure 10.

5. MONITORING THE STUDENTS PERFORMANCE

To monitor student's achievements through each examination period, especially at each question in the examination for all examination periods, the proposed software allows as monitoring all students whose performance is unsatisfactory in each learning skills for all question in examination periods. Therefore, the percentage of failed students in each learning skills at each question of examination periods are evaluated. For test 1 Q1-1 and Q1-2 measure the learning skill a1 and percentage of low performing students are 43.75% and 25% respectively. Q2 measures the learning skills a2 and b1 where the percentages of failed students are 25% and 18.75% respectively. Q3 measures the learning skills a2, b1, and c1 where the percentage of failed students are 18.75%, 43.75%, and 12.5% respectively, and Q4 measures the learning skills b2 and c2 where the percentage of failed students are 25% and 18.75% respectively. For test 2, Q6 measures the learning skill b2 and c2 and the percentage of failed students are 25% and 0%, Q7 measures the learning skills b2 and c3 where the percentage of failed students is 43.75% and 37.5% respectively, and Q8 measures the learning skills b3 and c3 where the percentage of failed students are 37.5% and 18.75% respectively. In the final examination Q1 measures the learning skill b1 and c1 and percentage of failed students are 43.75% and 25%, Q2 measures the learning skills b2 and c3

where the percentage of failed students are 50% and 50% respectively, Q3 measures the learning skills a3, b3, and c3 where the percentage of failed students are 37.5%, 0%, and 43.75% respectively, and Q4 measures the learning skills a4, b4, and c4 where the percentage of failed students are 6.25%, 18.75%, and 43.75% respectively. For the final lab examination Q1 measures the learning skills b2, d1, d2, d3, and d4 and percentage of failed students are 25%, 37.5%, 25%, 43.75, and 50%, Q2 measures the learning skills c2, d1, d2, d3, and d4 and percentage of failed students are 18.75%, 50%, 25%, 62.5, and 56.25%, Q3 measures the learning skills b3, c3, d1, d2, d3, and d4 and percentage of failed students are 43.75%, 43.75%, 37.5%, 31.25%, 56.75%, and 68.75%, Q4 measures the learning skills b4, c4, d1, d2, d3, and d4 and percentage of failed students are 31.25%, 43.75%, 31.25%, 37.5%, 62.5% and 31.25%.

6. CONCLUSIONS

The proposed method outlined above demonstrates an excellent approach to apply a combination of formative and summative for the course intended outcomes and shows student's achievements during all course activities and at each examination or assignments question for all course periods. Applying the proposed Excel program will leads the course instructor to have a bank of questions related to the course topics and modify this bank by adding or removing a question to it. The program can handle up to thirty questions per week and there is the ability to increase this number. The program helps instructor to think deeply when defining the CILOs in terms of level and to design activities and assignment to assess the CILOs. It leads to more easy and accurate assessment process and it enables the faculty to well define the course CILOs and aligned them with the program outcomes. In order to obtain accurate results, the course instructor must distribute the CILOs assessment percentages for each question in the examination period in a proper way, since it, leads to results based on the instructor distribution. To improve the student achievements the proposed program enables the course instructor to monitor the low performing students for each question per each examination period for each learning skills. Therefore, the course instructor can define the learning skills that the students who have unsatisfactory achievements with respect to each week, and identify the topics in which students performed poorly and plan for future improvement.

7. REFERENCES

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