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Course Outcomes Evaluation for Semiconductor Devices in the BSc in EEE Program

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Abstract
The current biggest challenge for engineering educators is helping undergraduates in engineering fields build complex, higher-order engineering skills. But it's not easy to assess and examine these skills using different types of coursework. There is a wide range of engineering courses taken by undergraduates. In order to create an effective syllabus, it is necessary to consider the objectives of each class. A course on semiconductor devices is one of several mandatory courses for the Bachelor of Science degree in Electrical and Computer Engineering. This course is an essential element of the BSc in EEE curriculum since its outcomes are congruent with some of the program's objectives. Therefore, it would be beneficial to assess the outcomes of the semiconductor device course comprehensively for the BSc in EEE program overall. This paper explains how the BSc in EEE program's Outcome-Based Education (OBE) course was evaluated and assessed. For a subset of students enrolled in the EE course at Southeast University (SEU) during the Fall 2019 semester, this report details the teaching strategies, course material, assessment data, and statistical analysis for the semiconductor device course. It also maps the course outcomes (COs) to the program outcomes (POs). All pupils have achieved or beyond the course instructor's benchmark, according to CO-PO analysis. As a part of the CQI process, certain recommendations were made to improve the final product even further.

Keywords: Abbreviation for Semiconductor Devices Course Objective-Based Instruction, Assessment, and Analysis.

I. Introduction
One of Bangladesh's most prominent professional groups, the Board of Accreditation for Engineering and Technical Education (BAETE) certifies engineering degree programs (BAETE, 2019). No one may apply for IEB membership if their degree program is not accredited. Still, an engineer's stamp of approval is required for the engineering design, and the IEB membership certificate is usually required for this. Obtaining accreditation is a goal of any engineering program director that cares about their students' employability. However, engineering schools that want to be accredited by the BAETE will need to make certain changes to their curriculum so that they are Outcome-Based Curriculums (OBCs) and adopt the Outcome-Based Teaching and Learning (OBTL) approach. With the implementation of an outcome-based curriculum starting with the Spring 2019 Semester in compliance with the BAETE OBE Manual (BAETE, 2019) (M. H. Bhuyan and A. Tamir, 2020; EEE-PO, 2020), this has led to an enhanced website for SEU's EEEcurriculum. The EEE division intends to execute the modifications outlined in the updated manual that is scheduled for release in December 2021 (BAETE, 2019).The number of engineering degree programs in Bangladesh is growing annually (UGC, 2020). Schools are therefore in a cutthroat race to attract bright first-year students. In other words, each school is aggressively pursuing recognition and approval. There can be no engineering degree programs without BAETE accreditation. The only current entity that awards degrees in engineering based on student performance in the classroom is BAETE. The new Outcome-Based Accreditation (OBA) regulation puts several engineering programs in Bangladesh at risk of losing their accreditation.are making the transition to an outcomes-based curriculum and, as a result, to the BAETE for OBA (BAETE, 2020).An OBE-based curriculum has been implemented by the SEU EEE Department beginning with the 2019 Spring semester. Aiming to generate course outcomes, map those objectives to the program as a whole, and then methodically and carefully analyze and evaluate those outcomes was the guiding principle in choosing the fundamental courses. The outcomes of the course will be assessed by direct assessment techniques (EEE-PO, 2020).We provide techniques for analyzing and evaluating the outcomes of a semiconductor device course in this paper. Furthermore, mappings between the course outcomes (COs) and the relevant program outcomes (POs) have been generated utilizing the weights and linking procedures. The BAETE Curriculum for the Bachelor of Science in Electrical and Computer Engineering includes twelve Program Outcomes (POs) (BAETE, 2019).

Review of the Literature
A fundamental need for accreditation in any engineering degree program is the attainment of a set of clearly defined qualities or program objectives via a variety of course outcomes at the time of degree completion (BAETE, 2019). Students' efforts

and growth during the semester are highly valued in the course outcomes. Students need to demonstrate mastery of at least one Bloom's taxonomy level—knowledge, skills, or attitudes—in order to pass a class (C. Asheim et al., 2017; H. A. M. Abdeljaber & S. Ahmad, 2017). N. A. Mustaffa et al. (2019) suggest that engineering programs may alter their curricula by using data on course outcomes to ensure quality and continuous growth.For an engineering program to follow the outcome-based curriculum and seek accreditation according to the Washington Accord (WA), it is essential to assess and evaluate different course outcomes (COs) in order to check if students have achieved the program outcomes (POs) (M. H. Bhuyan and S. S. A. Khan, 2020; M. H. Bhuyanand A. Tamir, 2020). Following the conclusion of a certain semester's worth of instruction to a designated group of students, we may evaluate the course's effectiveness. According to M. H. Bhuyan and S. S. A. Khan (2020), this method of assessment provides a transparent picture of the course learning outcomes and, by extension, the associated POs of a given cohort of students. This is also necessary for proposing and carrying out the program's process of continuous quality improvement (T. Sikander et al., 2017).By identifying and collecting students' attainment data, a sustainable assessment technique was built to compute their achievement of course learning goals and, by extension, the program outcomes. This was done to guarantee that undergraduate engineering education is of high quality (R. Mahadevan et al., 2013). According to ABET (2010), a solid assessment plan should include quantitative and qualitative metrics in addition to direct and indirect indicators.According to R. Terry et al. (2007) and P. Jayarekha and M. Dakshayini (2014), the course and program outcomes are primarily measured by direct and indirect assessment methods. According to J. Shaeiwitz and D. Briedis (2007), direct assessment methods are often used to assess the course learning results. Undergraduates studying electrical and electronic engineering could have a better idea of how to complete a certain PO by following this process.You may conduct direct evaluation by consulting the course's learning goals and assessment strategy. Each piece of evidence demonstrates the student's level of competence in a certain area. A common application for this sort of assessment is to determine the program's ultimate purpose. A lot of factors are dependent on the direct assessment approach. The questions on various assessments, including quizzes, in-class examinations, midterms, and finals, are one example (H. A. Harvey et al., 2010; M. H. Bhuyan and S. S. A. Khan, 2020).

Measuring the course results is another approach proposed for the direct evaluation.

COs and POs) depending on a predetermined set of performance measures that are highly correlated with the courses that are taught (H. Gurocak, 2008; L. Alzubaidi, 2017). According to G. Rogers (2003), these performance indicators were specific quantitative qualities needed to fulfill the POs.

In order to graduate from the bachelor's program in Electrical and Electronic Engineering, one must have studied semiconductor devices. This research module is also known as a solid state device. Academic success and completion of course goals may be difficult for students due to the advanced nature of the subject matter. Because of this, there have been a lot of long-term initiatives to ensure that students have access to the concepts and models. In this particular setting, e-learning proved to be a strong tactic for dealing with such difficulties. According to G. K. Singh (2011), the researchers relied heavily on online lecture videos on semiconductor devices, as well as web and applet-based e-resources, to help students achieve the course learning objectives. On the other hand, M. H. Bhuyan and S. S. A. Khan (2018) found that faculty motivation was helpful in overcoming challenges to obtaining course outcomes.

Students in a semiconductor device course using the SUPREM software package reported significantly greater levels of satisfaction and self-assessment of course outcomes after using a revolutionary method called Integration of Knowledge. Researchers M. E. Rizkalla and C. F. Yokomoto (2001) used this software to teach students how to create semiconductor devices with three or four terminals.

Secondary Objectives of the Work

Finding an appropriate way to analyze and assess the course learning outcomes of is the primary goal of this effort. Earning a Bachelor of Science degree in Electrical and Computer Engineering will be aided in part by the coursework you take in semiconductor devices. The following are some of the secondary objectives of this endeavor: i. a literature study on objective behavior evaluation (OBE) methods for evaluating semiconductor device and associated course work

ii) Make a system to test the students' understanding of what they've covered in Semiconductor Devices.

iii) Provide extensive knowledge of electrical and electronic engineering problems pertaining to device design.

It would be fair to assess and grade each student's performance in the semiconductor device class.

v. Find out how great the students are at putting their knowledge of semiconductor devices to use in the actual world.

vi. Assess the current state of the course, think about how it may be improved, and then suggest changes to the CQI program chair.

Methods

Among SEU's undergraduate engineering programs, Electrical and Electronic Engineering (EEE) stands out for its rigor and popularity. The question of how current its accreditation is, however, is of relevance to prospective students. Getting the program acknowledged as soon as possible would be quite wonderful, according to the leader of the program. The major motivation behind this daring step is to raise money for the program's expansion so it can meet the national and institutional standards for engineering education at the university level. Currently, the only way to ensure that a program's curriculum, teaching, and assessment are all focused on the program's goals is to ensure that they are at the center of each component. According to M. H. Bhuyan and A. Tamir (2020), the EEE department is responsible for determining the most relevant performance indicators for measuring course outcomes (COs) and, therefore, program outcomes (POs). Hence, starting with the 2019 Spring Semester, the EEE Department has instituted a curriculum based on OBE and set up pedagogical practices, assessment tools, and evaluation protocols based on OBE. With these guidelines in mind, we were able to design a framework to use a number of direct evaluation tools to find out how well the Program Outcomes (POs) were achieved. Consequently, each semiconductor device's COs were allocated to one of the twelve POs provided by the BSc in EEE program. This is the responsibility of the appropriate course teacher. Having decided what the course goals are, the following stage is for teachers to figure out how to evaluate their students' progress. The verbs of action used to establish COs, how those objectives relate to performance goals, and Bloom's Taxonomy of Learning Objectives should all be considered by the course teacher while developing questions for each CO. Afterwards, the linked POs are determined by using the evaluation information of COs. Information received from teachers' course assessments is used to compute each student's PO. R. Mehdi and M. A. Naaj (2013) state that when the results are finalized, they are submitted to the POs after undergoing a second round of corrections.

Section A: Contents of the Course

The course contents of a program provide us a general notion of what students could study in any given class. Thus, it is crucial to plan it such that program instructors and students alike can see the big picture of a course, understand the material that will be covered, and come away from the experience with the skills that will be useful in the future. On the other hand, if the course covers too many unconnected subjects, it could detract from the intended outcomes. The primary subjects of the semiconductor device class are as follows:

Within the framework of "equilibrium" semiconductors, topics such as electron and hole concentrations, Fermi levels, the temperature dependence of carrier concentrations, and the invariance of the Fermi level are covered. Carrier drift/diffusion, generation/recombination, built-in-field, Einstein relations, and continuity/diffusion equations for holes/electrons at the quasi-Fermi level are involved in the excessive carrier transport processes. This comprehensive review of PN junctions covers a wide range of issues, including bias (forward and reverse), carrier injection, currents (minority and transient), AC conditions, temporal variation of stored charge, reverse recovery transient, capacitance, and more. The Bipole Joint Emission efficiency, current gain, base transport factor, diffusion

Transistors include a wide range of concepts, including base-equation equations, terminal currents, coupled-diode models and charge control analyses, Ebers-Moll equations, and circuit creation. Potential energy distribution at rectifying and ohmic connections between metal and semiconductor. The structure of MOS includes static C-V characteristics, the body effect, the current-voltage relationship of a MOSFET, and the qualitative theory of MOSFET operation. Energy band diagrams, the MOS capacitor, and the flat band voltage are other components. "Junction Field-Effect Transistor" (EEE-CC, 2020) provides a comprehensive introduction to junction field-effect transistors, including topics such as pinch-off voltage, the current-voltage relationship, and a general description of the device.

Results of the Class (B)

Any engineering program worth its salt will have a Course Learning Outcome (CLO) or just Course Outcome as its bedrock. It informs everyone involved—students, instructors, employers, and parents—of the concrete, quantifiable goals that a course may help students achieve. As a result, a Course Outcome (CO) is something that can be described in depth, shown quantitatively, and visually. It lays forth the desired outcomes of education in great detail, including the knowledge and skills that students should acquire.

A set of clearly stated course outcomes (COs) includes the following components (V. K. Chandna, 2015):

i. Action verbs as defined by Bloom's taxonomy

ii. The scope of the research

iii) The score that each student gets on a certain assignment

The extent to which students can finish an activity in a certain setting (optional)

From the first year of the electrical and electronic engineering degree to the final year, an OBE-based curriculum may include more lower-level and higher-level course outcomes, but the semiconductor device course is an absolutely necessary core course for undergraduates. It is critical that you do well in this course since it serves as a basis for both required and elective coursework at the subsequent level. Instructors in the subject of semiconductor devices should so check that their students get a thorough understanding of the subject as a whole. Several theorems and laws relating to the physics of semiconductor devices are covered in this three-credit theoretical course. Also included are comprehensive models of semiconductor devices for use in circuit simulations.This led to the formulation of course-specific learning goals. When writing up the course outcomes, we used the active verbs that worked best with each CO. Our final list of five class goals for semiconductor devices is as follows:-Upon graduation, students will be able to:

carbon monoxide carbon dioxide A thorough explanation of the fundamental occurrences and concepts that impact semiconductor behavior would be much appreciated. Make use of energy band diagrams to show how various devices react to bias changes.

Carbon monoxide Derive the relevant equations [CO4] to model the dynamic behavior of semiconductor devices. Determine the performance characteristics and how various semiconductor devices work [CO5]. One way to determine the parameters of a semiconductor device is to look at its characteristic curve.

Section C. Program Outcomes, Division C

Program The information, abilities, and attitudes that a graduate of an engineering academic program should be able to exhibit directly after the degree completion are specified as outcomes (POs). An academic program's graduate is characterized by these results. The program outcomes of an engineering degree are generalizations about the knowledge, attitudes, and abilities that students gain from a curriculum that covers a wide range of theoretical topics and practical applications in the classroom and lab. Program results define the total from those parts by integrating them, while course outcomes show how knowledge, skills, and attitudes form the program's framework. At the end of the program, it shows that the students have learned a lot from all the classes.

Following the guidelines set forth by the UGC, Bangladesh (UGC, 2018) and BAETE, Bangladesh (BAETE, 2019), the Bachelor of Science in Electrical and Electronic Engineering program's OBE-based curriculum requires a minimum of 153 credits, with 72 of those credits serving as core courses. The twelve engineering program objectives from the BAETE Manual are immediately included into the BSc in EEE curriculum with the use of the relevant modifiers as needed. Thus, twelve POs are anticipated of program graduates upon graduation (EEE-PO, 2020). The following is a description of the three points of entry (PO1, PO2, and PO4) into the Bachelor of Science in Electrical and Electronic Engineering (BSc) program that correspond to the five content areas (COs) of the semiconductor device course, as per the BAETE handbook (BAETE, 2019):

[PO1] Engineering Knowledge: Solve complicated electrical and electronic engineering problems by applying what you've learned about mathematics, science, engineering fundamentals, and your engineering specialization; [PO2] Problem Analysis: Using what you've learned about mathematics, the natural sciences, and engineering, isolate the problem, formulate a solution, and conduct research to back up your claims; [PO4] Investigation: Solve difficult issues in electrical and electronic engineering via research, taking into account experimental design, data analysis, interpretation, and synthesis;

The CO-PO system Performance Evaluation and Mapping

The "Performance Indicators" (PI) or "Key Performance Indicators" (KPIs) developed by the American Board of Educational Technology (ABET) in 2010 provide some of the best recommendations for evaluating students' progress in their program. The key to finishing the course is using the right key performance indicators (KPIs). Using direct measurement techniques, we may quantify the degree to which students grasp each learning outcome related to the semiconductor device course content. It is expected that the records for the semester will be kept by each course's teacher. Students get letter grades at the conclusion of each semester that are based on their percentage of CO attainment. This allows them to demonstrate that they have completed their PO objectives (H. Gurocak, 2008; EEE-PO, 2020).Attaining any program objective via different course outcomes requires knowledge, skills, and attitudes. Members of the facultymust establish a number of performance indicating criteria for the semiconductor device course, together with the BT domains and levels that correlate to them, as well as suitable pedagogical approaches, evaluation tools, and course materials. Appropriate teaching-learning techniques should also be developed in order to impart correct course content and equip students with the essential abilities at different levels of the cognitive domain. Some articles (M. H. Bhuyan, 2014; M. H. Bhuyan and S. S. A. Khan, 2014; M. H. Bhuyan et al., 2014; M. H. Bhuyan et al., 2018) have shown that using Bloom's taxonomy to organize concepts in electrical and electronic engineering courses at the undergraduate level is more effective than using traditional methods of instruction.

Table 1 displays the CO-PO mapping, degrees of teaching and learning in the cognitive domains of BT, methods of teaching and learning delivery, and different evaluation components for CO measurement.

Table 1: CO-PO mapping, taxonomy domain, teaching-learning strategy, and assessment tools of the semiconductor device course

Course Outcome	PO	Taxonomy Domain/Level	Teaching-Learning Strategy	Assessment Strategy
[CO1] Explain the physical phenomena and principles that govern the semiconductor behavior properly	PO1	Cognitive/ Understand	Lectures Discussion with the students Question and answer session	Class Test Assignment
[CO2] Draw the energy band diagrams of various devices to explain their behavior under various biasing conditions	PO1	Cognitive/ Apply	Lectures Discussion with the students Question and answer session Problems solving in the class	Class Test Assignment Midterm Exam
[CO3] Derive semiconductor device equations for modeling their dynamic behavior	PO2	Cognitive/ Understand and Apply	Lectures Question and answer session Problems solving in the class	Class Test Midterm Exam
[CO4] Compute the operational and performance parameters for various semiconductor devices	PO4	Cognitive/ Apply and Analyze	Practical demonstration Problems solving in the class Question and answer session	Class Test Assignment Final Exam
[CO5] Determine the semiconductor device parameters from their characteristic curves	PO4	Cognitive/ Analyze and Evaluate	Problems solving in the class Discussion with the students Question and answer session	Class Test Assignment Final Exam

Table 2: Assessment Plan of Semiconductor Device Course

Assessment Tool				Mapping with Course Outcome				
Item	**Q#**	**Cognitive Level**	**Allotted Marks**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Class Test1	Q2	C2: Understand	3.0	√				
Class Test2	Q3	C3: Apply	3.0		√			
Class Test3	Q3	C3: Apply	3.0		√			
Midterm Examination	Q1(a)	C2: Understand	3.0			√		
	Q1(b)	C3: Apply	4.0			√		
	Q2(c)	C3: Apply	4.0		√			
	Q3(a)	C2: Understand	5.0	√				
	Q4(a)	C4: Analyze	4.0				√	
	Q4(b)	C3: Apply	3.0			√		
Final Examination	Q1(a)	C2: Understand	3.0			√		
	Q2(a)	C3: Apply	5.0				√	
	Q2(b)	C5: Evaluate	5.0					√
	Q3(a)	C4: Analyze	3.0					√
	Q4(a)	C3: Apply	3.0				√	
	Q5(b)	C5: Evaluate	4.0					√
Total	**15**	**-**	**55.0**					

Table 3: Percentage distribution of questions as per levels of Bloom's taxonomy in the cognitive domain

Cognitive Levels		Questions			
Level #	**Level Name**	**Number of Questions**		**Marks of Questions**	
		In Count	**In %**	**In Number**	**In %**
C2	Understand	4	26.7%	14	25.5%
C3	Apply	7	46.7%	25	45.5%
C4	Analyze	2	13.3%	7	12.7%
C5	Evaluate	2	13.3%	9	16.4%
	Total	**15**	**100.0%**	**55**	**100.0%**

The components that comprised the CO semiconductor device course are detailed in Table 2. These instruments include, among other things, multiple-choice quizzes, midterms, and final exams, as well as ongoing or formative assessments. At SEU, you may expect to get 30% for your midterm, 40% for your final exams, and 30% for your continuous evaluation. In addition to the test question numbers, marks, cognitive domain levels, etc., Table 2 also presents the examinations. For the

semiconductor device course, it is assumed that COs and POs have straightforward correlations (M. H. Bhuyan and A. Tamir, 2020).
Equation (1) is used to compute the COs of this course.

$$CO_i = \frac{\sum_{j=0}^{j=N} OM_j}{\sum_{j=0}^{j=N} AM_j} \times 100\% (1)$$

, for each course outcome (COi), where N is the total number of questions to be considered from different types of direct assessment exams, OMj is the student's mark against an exam question for COi, and AMj is the mark assigned to a question for the ith CO.
To calculate the POs, we use equation (2). Still, this is a step in the right direction for one PO. After adding up all of the COs from all of the classes, we get the final PO values.

$$PO_k = \frac{\sum_{i=0}^{i=n} TOMCO_i}{\sum_{j=0}^{j=n} TAMCO_i} \times 100\% \qquad (2)$$

TAMCOi is the total allotted mark of different questions considered for the ith course outcome (COi), TOMCOi is the total obtained mark by a student from different examinations for that CO, and n is the total number of program outcomes (POk) that are considered for that CO.Based on Bloom's taxonomy, Table 3 displays the proportion of questions distributed in Table 2's assessment plan according to different levels of the cognitive domain. This distribution is based on the number of questions and the quantity of marks each question was assigned (M. H. Bhuyan and S. S. A. Khan, 2020). Table 4 shows the achievement level measurement scale that should be utilized. The data in Table 2 reveal that this is based on the proportion of marks that each CO received from various direct evaluation techniques. First, we set the CO achievement objective as 50%. Given that the minimum passing CGPA at SEU is 2.5 on a scale of 4.00, which is comparable to 50% marks, this was the minimal benchmark at the early stage of CO assessment. According to Table 4 (M. H. Bhuyan and S. S. A. Khan, 2020), half of the students enrolled in the semiconductor device course should achieve an acceptable or benchmark level, which is 50% of the total enrollment.

Table 4: Performance scale based on the percentage ofmarks obtained

Performance Level		Numerical Scale
Excellent	Achieved	80% and Above
Very Good		70-79%
Good		60-69%
Satisfactory		50-59%
Developing	Not achieved	40-49%
Unsatisfactory		Below 40%

Evaluating the PO

Table 1 shows that every course officer (CO) in the semiconductor device class has been assigned a specific PO so that we can see how far along the path to completion each student is. M. H. Bhuyan and A. Tamir (2020) provide the following techniques for counting the achievement of each PO:

i. Any given CO may only contribute to one PO.

ii) By combining CO1 and CO2, as shown in Table 1,

aid in the completion of PO1, CO3 on its own facilitates the completion of PO2, and CO4 and CO5 working in tandem facilitate the completion of PO4.

in order to determine each student's PO, the percentage of total scores is computed.

iv. When the proportion of pupils rated as "Excellent," "Very Good," "Good," or "Satisfactory" is equal to or more than 50%, we say that the program has achieved its outcome.

an. The following criteria are used to calculate the PO standing:

obtained if the score is less than 50%

I need to retake the course in order to get COs and POs if my score is less than 40%, which means I am unsatisfied and at the unachievable stage.

a.ii. Achieving COs and POs requires extra attention if the score is between 40% and 50%, which is now unattained and in the developmental stage.

obtained a score of at least 50%

b.i. A score that is slightly obtained is 50% but less than 60%.

b.ii. Achieved a score of 60% or above but below 70% — still requires work on knowledge and skill levels.

b.iii. Achieved a very excellent status with a score of 70% but less than 80% - still has room for development in a few areas of knowledge and abilities.

a.iv. Achieved with an outstanding rank—score of 80% or higher

F. Collecting Data

The data for the CO and PO evaluations came from the Fall 2019 semester's semiconductor device class. Some courses from the previous curriculum were also used to determine the CO-PO achievement to ensure the validity of the OBE technique, since the EEE Department began to apply the OBE-based curriculum in the Spring 2019 Semester. It is common practice to provide a semiconductor device course during the second semester of the third year. There were 34 former curriculum students that enrolled in this class during the 2019–20 fall semester. In order to determine CO and its impact on PO, we used all of the direct assessment data in accordance with the evaluation strategy in Table 2. No instrument for indirect evaluation was used.

Part II: Analyses, Data, and Discussions

Part A: CO-PO Assessment

Based on the total number of students enrolled in the CO and PO programs, Table 5 and Table 6 correspondingly describe the course and program outcomes' achievement status. The necessary technical expertise is shown in Tables 5 and 6, which compile data on the physics, materials, equations, laws, and theorems related to semiconductor devices. All twenty-four students who took part in the class met or exceeded the minimal satisfaction requirement. We may conclude that the students successfully completed the course and achieved the program goals via the semiconductor device course as it is higher than the benchmark level (minimum 50%) established by the program. Because this was an experimental course for the EEE department, the instructor took extra effort to ensure that all students could pass with honors.

The results of the CO and PO achievements are shown in Figures 1 and 2, respectively, based on the evaluation data. All students were able to complete all course objectives (COs) and make progress towards their personal objectives (POs) since the course achievement standard was set at 50%. Nevertheless, it may be improved upon.

Table 5: Total number of students passing the semiconductor device course at SEU's EEE department

Course Outcome	Excellent	Very Good	Good	Satisfactory	Developing	Un-satisfactory
CO1	12	10	2	0	0	0
CO2	11	8	5	0	0	0
CO3	15	5	3	1	0	0
CO4	14	6	3	1	0	0
CO5	13	9	1	1	0	0

Table 6: Number of students achieving the performance levels for various POs through the semiconductor device course only at the EEE Department

Course Outcome	Excellent	Very Good	Good	Satisfactory	Developing	Un-satisfactory
PO1	14	7	3	0	0	0
PO2	15	5	3	1	0	0
PO4	12	9	3	0	0	0

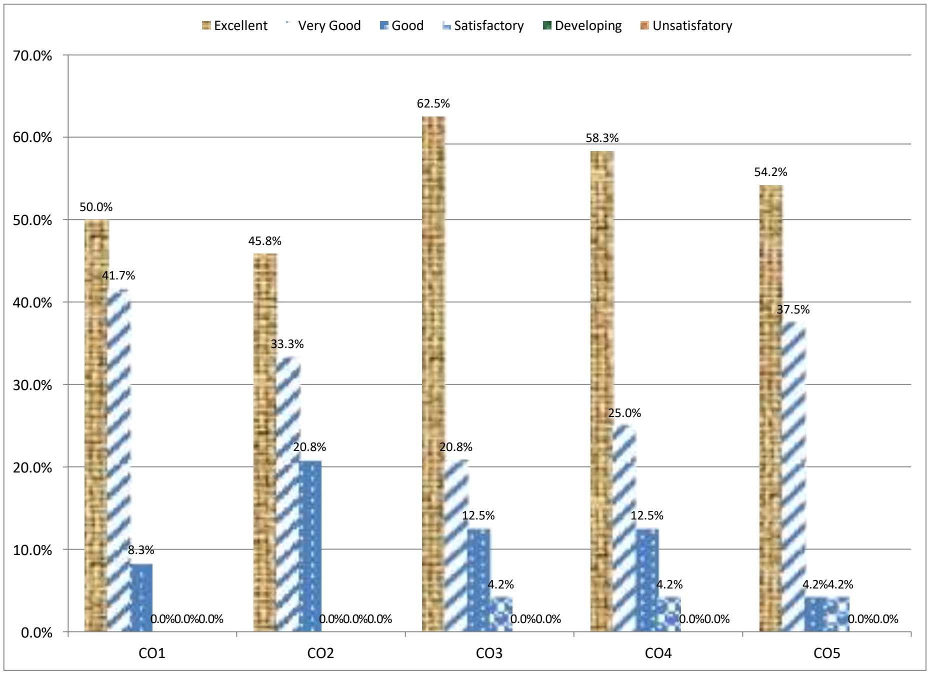

Figure 1: Summary of CO attainment chart

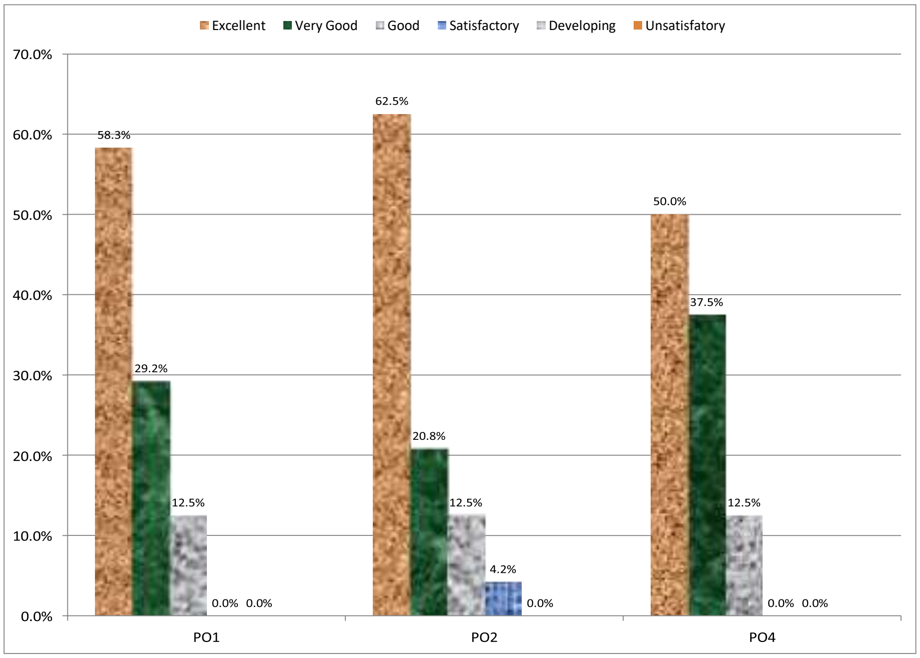

Figure 2: Summary of PO attainment chart

B. Suggestions for Improving Things in the Future

A collection of feasible and efficient strategies for further increasing accomplishment levels has been devised. Whether a professor decides to update the course content or make changes to help a particular student learn more effectively is mostly up to him or her. One instructor is seldom limited to the suggested measures; instead, there is space for creativity in one or more remedial methods to help students improve their accomplishment levels. When it comes to training for semiconductor devices, here are a few fixes that have been suggested:Increasing the amount of numerical problems and derivations given to students as homework; b. Increasing class participation through more group and individual projects leading to a relevant course objective on semiconductor devices; c. Giving students who need it more time in tutorials; d. Having enough textbooks and reference materials to cover the material; and e. Using an effective method of instruction.

One seasoned professor in the EEE department focuses his research on modeling, simulation, and design of semiconductor devices from a physics perspective. This task, together with documenting the CO-PO accomplishments of the semiconductor device course at the conclusion of each semester, necessitates the recruitment of more senior faculty members. Students enrolled in the semiconductor device course the next semester will continue to use the aforementioned remedial procedures recommended by their previous semester's instructor if they show substantial progress in their CO-PO scores.

Section II: Findings

Evaluating the impact of the semiconductor device course on three broad program goals (POs) and their respective outcomes (COs) is laid out in this research. The BSc in EEE program uses this concept in its accreditation process, namely via its OBE curriculum and teaching-learning methodologies. This simple technique uses a few of easily quantifiable factors to get an estimate of the amount of CO achieved.

Students' cognitive understanding is tested using a battery of carefully constructed performance indicators once they finish the semiconductor device course.In order to evaluate the course's success, the responsible teacher should use an appropriate evaluation technique. By asking questions at more advanced levels of the cognitive domain (from Apply to Create), the OBE method may help students reach the course goals. As a result, other approaches to question formulation have also been described. The assessment and evaluation data and recommendations can be used by the relevant academic program head and university administration to improve the program and attract more students in the future. This can be achieved by developing plans for the program's sustainable expansion. Moreover, it will facilitate the professional advancement of SEU's EEE grads, who will in turn be able to contribute to the nation's economic prosperity.

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