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Attainment of Course Outcomes (COs) and Program Outcomes (POs) in Outcome Based Education (OBE)

K. Thangaraj[1], S. Anbumalar[2], P. Jamuna[3], A. Janagiraman[4]
[1, 4] Assistant Professor, EEE, Sri Manakula Vinayagar Engineering College, Puducherry, India
[2, 3] Professor, EEE, Sri Manakula Vinayagar Engineering College, Puducherry, India
[1] thangaraj.electres@gmail.com,
[2] saravanananbumalar@gmail.com,
[3] jamuna@smvec.ac.in,
[4] janagiraman16@smvec.ac.in

Abstract—Quality assurance and upgrading processes play a pivotal role in checking whether te set educational objectives meet a typical quality in education. To guarantee this, the National Board of Accreditation (NBA) has instituted a novel Outcome Based Education system. As per the criteria established by the NBA, a fundamental requirement is the evaluation of Course Outcomes (COs), Program Outcomes (POs), and Program Specific Outcomes (PSOs). It assesses the expertise, knowledge, and attitudes that students acquire through the program. Achieving Program Outcomes is possible through the successful completion of Course Outcomes associated with that particular program. It helps to improve students' technical skills, knowledge, and attitudes. This paper presents an approach for assessing the achievement of both course and program outcomes. It also provides recommended target values to measure the degree of intended growth in students after a teaching and learning process.

K. Thangaraj
Assistant Professor, EEE,
Sri Manakula Vinayagar Engineering College, Puducherry, India
thangaraj.electres@gmail.com,

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1. Introduction

Outcome-Based Education (OBE) is a pedagogical approach that emphasizes achieving specific outcomes in student learning. This educational framework ensures that the curriculum, teaching methods, and assessments are aligned to ensure that students demonstrate a mastery of predetermined knowledge, skills, and abilities by the end of their academic programs. OBE has gained prominence in higher education, particularly in engineering and technical fields, where the link between academic performance and real-world competencies is crucial.

OBE shifts the focus from traditional education models that prioritize input (teaching methods and content) to one that stresses output—what students are expected to achieve. Educational institutions are increasingly adopting OBE, driven by industry needs, technological advancements, and the accreditation requirements set by organizations such as the National Board of Accreditation (NBA).

The NBA advocates for OBE to ensure that students not only acquire theoretical knowledge but are also able to apply it in practical, professional settings.

Yousef Abosalem (2016) discusses how the concept of OBE has evolved over the past decades, supported by research in educational assessments, learning taxonomies, and future skills development. The assessment of students' higher-order thinking skills, including analysis, evaluation, and creation, plays a pivotal role in determining their success within the OBE framework.

Anderson, L. W., and Krathwohl, D. R. (2001) introduce a revised version of Bloom's taxonomy, which provides a structured approach to formulating learning outcomes and assessing student performance, making it a vital tool for OBE.

Redecker, C. et al. (2010) emphasizes the need for educational systems to anticipate future skill requirements. This study examines how future learning environments should adapt to foster new skill sets that align with emerging job markets. This aligns with the goals of OBE, which seeks to prepare students not just for the present but for the evolving demands of their respective industries.

Crespo, R. M. et al. (2010) highlight the importance of aligning assessment methods with learning outcomes. Ensuring that assessments accurately reflect the intended learning outcomes is essential for measuring student progress effectively. In this regard, aligning assessment with learning outcomes has been demonstrated to improve educational transparency and effectiveness. The NBA's accreditation process reinforces this alignment, requiring institutions to demonstrate the attainment of course outcomes (COs) and program outcomes (POs) through structured assessments and evaluations.

Lavanya, C., & Murthy, J. N. (2022) analyze case studies in engineering education to assess the effectiveness of OBE in measuring CO and PO attainment. Masni-Azian et al. (2014) illustrate how proper alignment between COs and POs in product design and development courses can significantly enhance educational outcomes. Surendar Rawa and Shruti Karkare (2015) further validate the empirical benefits of OBE in technical courses, particularly when using structured, data-driven approaches to assess CO attainment.

Bhimasen Soragaon and Mahesh K. S. (2016) describe various technological tools developed to assist institutions in monitoring and assessing student performance within the OBE framework. Abhishek Koshti et al. (2016) examine how these tools facilitate the tracking of student outcomes, making it easier for institutions to gather data necessary for accreditation. Geeta Deswal et al. (2016) present an assessment method that integrates these tools with OBE principles, demonstrating its effectiveness in evaluating course and program outcomes across various technical education settings.

Priti Kudal et al. (2017) and Haidar M. Harmanani (2016) introduce innovative assessment methods, such as curriculum-based exit exams, to provide a more comprehensive evaluation of student learning. Suji Prasad, S. J., Thangatamilan, M., Sureshkumar, R., & Revathi, P. (2023) and Chia Pao Liew et al. (2020) discuss how these exams serve as a summative evaluation tool, ensuring that students meet the desired outcomes by the time they graduate. Diganta Sengupta et al. (2024) propose the Federated Education Learning (FedEL) system, which integrates the Internet of Education Things (IoET) to establish correlations between COs and POs, thereby optimizing outcome-based assessments.

R. Shah and A. L. Gillen (2023) conduct a systematic review of university-industry partnerships, highlighting their importance in engineering education. These collaborations help ensure that the skills students develop align with industry expectations, reinforcing the value of OBE. Kumar, K. S. A., Worku, B., Hababa, S. M., Balakrishna, R., & Prasad, A. Y. (2021) investigate how project-based learning approaches enhance program outcome attainment and positively impact student learning, particularly when integrated with modern assessment tools like fuzzy inference systems.

The continual refinement of OBE models in response to new educational challenges and technological advancements underscores the dynamic nature of this approach. As institutions integrate these new models and tools, they can provide students with an education that not only meets current demands but also equips them for future success.

The Flowchart illustrating the procedures implemented to attain COs, POs, PSOs, & PEOs is shown in Fig. 1.

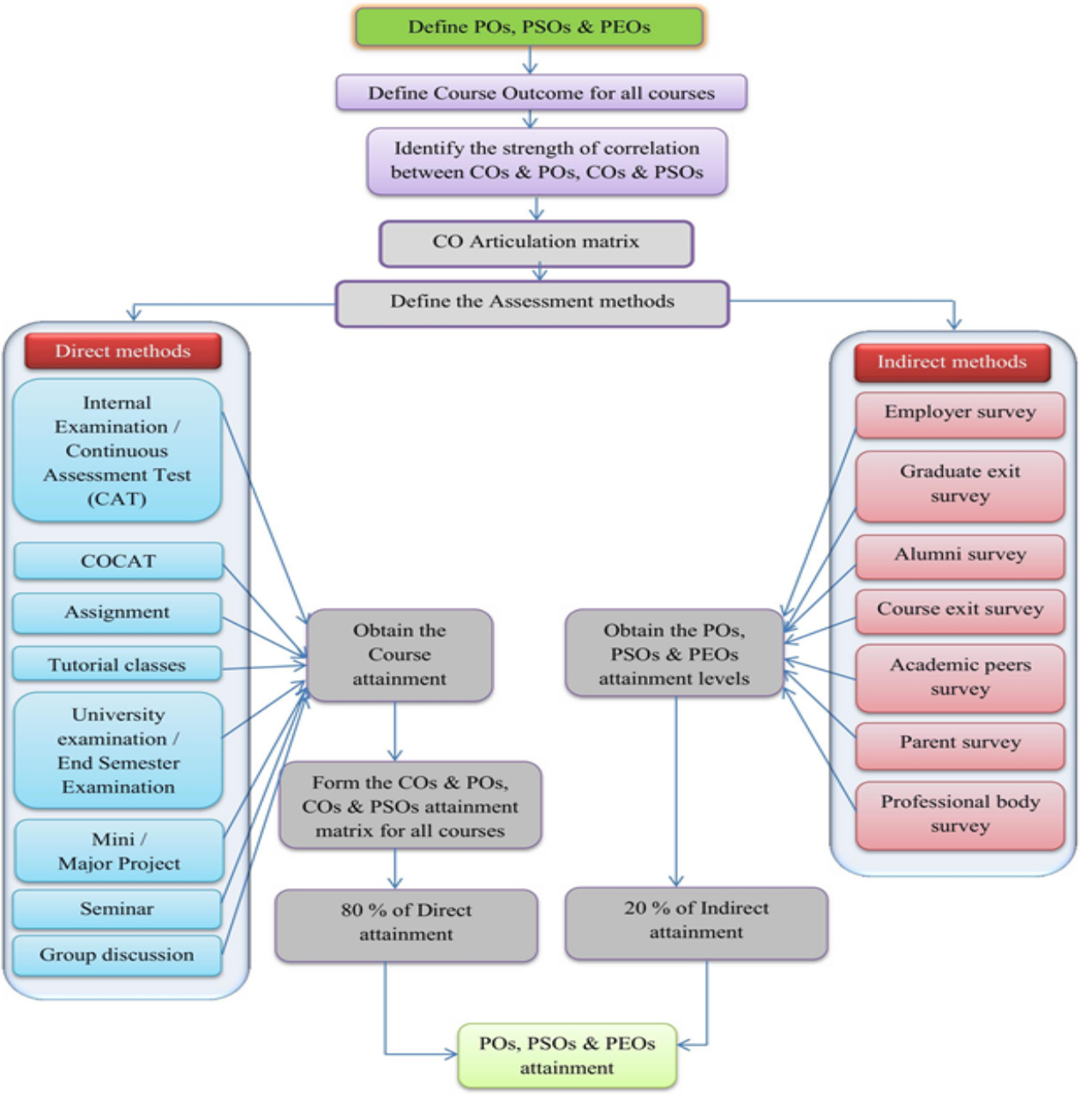

Fig. 1 Flowchart illustrating the procedures implemented to attain COs, POs, PSOs, & PEOs

2. Attainment Of Cos And Pos

The process of defining COs, POs and PSOs commences with the formulation of precise COs derived from the syllabus designed for each course within the comprehensive four-year engineering degree program.

Individual faculty member is responsible for crafting the course outcomes (COs) after a thorough comprehension of the syllabus content. Subsequently, they are tasked with correlating these COs with the Program Outcomes (POs) on a scale ranging from 1 to 3, where 1 indicates a low correlation, 2 signifies a moderate correlation, and 3 denotes a high correlation. Based on the correlation between COs and POs, a mapping matrix will be formed for individual course in the program. The curriculum and syllabus committee will be formed and the team will review the course outcomes and its mapping regularly. The sample course has shown the COs, CO-PO mapping matrix and CO-PSO mapping matrix in Table I.

Table I :
Mapping Of Course Outcomes With Program Outcomes

Course Name:	**ELECTRICAL MACHINES – I**
Course Code:	**U19EET34**
Regulation:	**R2019**

Course Outcomes

Upon completion of the course, students will acquire the proficiency to
CO1 - Analyze the performance of DC machines under various operating conditions using their characteristics **(K3)**
CO2 - Interpret the efficiency of DC machines by conducting Suitable tests. **(K3)**
CO3 - Inspect the performance of single phase transformers using phasor diagrams and equivalent circuits and understand the charact eristics of special transformers. **(K3)**
CO4 - Outline the different types of connections in three phase transformers and savings of copper in autotransformers. **(K2)**
CO5 - Interpret the efficiency of Transformers by conducting Suitable tests. **(K3)**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	1	-	-	-	-	-	-	1	3	3	2
2	3	2	2	-	1	-	-	-	-	-	-	1	3	3	2
3	3	3	2	-	1	-	-	-	-	-	-	1	3	3	2
4	3	3	3	-	1	-	-	-	-	-	-	1	3	3	2
5	3	3	3	-	1	-	-	-	-	-	-	1	3	3	2
CO	**2.8**	**2.6**	**2.4**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**2**

Summative assessment, as implied by its name, takes place upon completion of the all-inclusive teaching and learning process for a given course. It evaluates the outcomes achieved at the conclusion of the course. Utilizing the mapping matrix delineating COs, POs, and PSOs across all courses, a comprehensive 'Program-level COs–POs matrix' and 'COs–PSOs matrix' are developed.

A model course for examining the fulfilment of POs via COs has been taken for calculation. Additionally, the estimations should be accomplished for all the courses as appeared in Table II. POs commitments of the considerable number of courses are combined and average should be calculated. The result obtained will constitute the Program Outcome for that particular programme.

Table II :
Program Level Cos – Pos Matrix Of All Courses Including First Year Courses

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
U19BST101	2.6	1.6	0.6	0.6	-	0.8	0.8	-	-	-	-	1	2	1	1
U19BST102	3	3	2.6	2.2	2.8	-	-	-	-	-	-	-	1.6	2	1.8
U19BST103	2	1	-	-	-	1	1	-	-	-	-	1	1.8	1	-
U19BST110	3	1.5	2.3	1.2	1.2	1.8	1.5	-	0.5	1	0.5	3	0.7	0.7	0.5
U19BST111	3	2	2	3	-	-	-	-	-	-	-	1	1.6	1	1
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EET33	3	3	3	2	1	-	-	-	-	-	-	-	3	2.4	2.4
U19EET34	2.8	2.6	2.4	-	1	-	-	-	-	-	-	1	3	3	2
U19EET35	2.3	2.7	2.5	2.8	2	-	-	-	-	-	-	1	2	3	3

. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEP81	3	3	3	3	-	-	-	-	-	-	-	1	2.6	1.8	2.2
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEW81	2.6	2.6	2.6	1.4	0.4	0.8	1.2	1.2	3	3	1.6	1	2.4	2	2.2
Average	**2.5943**	**2.0674**	**1.8611**	**1.5485**	**1.3777**	**0.3251**	**0.2311**	**0.0933**	**0.5604**	**0.2038**	**0.1340**	**0.8679**	**1.9779**	**1.9294**	**2.0519**

3. Assessment Processes

The program consists of several courses, each contributing to the overall attainment assessment. By mapping these courses to program outcomes, the program's attainment is analyzed. This evaluation aims to ascertain the extent of student transformation regarding attitude, skills, and knowledge upon completing the program.

Student performance can be evaluated by means of the attainment process, during which students accumulate knowledge as they advance through the course. The evaluation of course outcomes (COs) is determined by various means including internal examinations, end-of-semester exams, as well as assignments for both theoretical and laboratory courses. This evaluation is accomplished through both direct and indirect methods. Direct methods involve conducting examinations, while indirect assessment is conducted through surveys to gauge stakeholder perceptions.

Traditionally, the student's accomplishment has been indicated by their cumulative marks or grades. The higher these scores, the greater the perceived overall attainment across all outcomes. However, Outcome-Based Education (OBE) highlights the significance of Graduate Attributes (GA) via Program Outcomes (POs) and Course Outcomes (COs), permitting the assessment of each outcome is assessed using specific questions. Each question should be formulated to correspond to a suitable range of knowledge, thus effectively encompassing all course outcomes.

To estimate the attainment of COs, POs, and PSOs, each institution typically carries out a process or multiple processes for Outcome-Based Education (OBE), involving the identification, collection, and preparation of relevant data.

COs, POs and PSOs Assessment Tools

The Assessment processes are divided into direct and indirect methods.

- Direct assessment
- Indirect method

1. Direct assessment

Direct assessment relies on the direct measures which performed during the semester. The COs and POs are measured for each student through examinations and knowledge test. The faculty member monitors the student performance and records it continuously throughout the semester. Then the course outcomes will be calculated for the specific subject to the individual students. The direct assessment methods adopted are:

- Continuous Assessment Test (CAT)
- Assignment
- Tutorial Classes
- Group Discussion
- Course Outcome and Course Achievement Test (COCAT)
- University Examination / End Semester Examination
- Seminar
- Mini / Major Project

By directly assessing students' knowledge and skills, these methods provide a clear indication of how

well specific learning outcomes are being achieved. The results from these assessments are used to gauge the effectiveness of the teaching and learning process and to inform any necessary adjustments for improving course delivery and student understanding.

Table III :
Continuous Assessment Test (cat) Attainment

Level 1: 65 % and above of Students Secured ≥ 70 marks

Level 2: 70 % and above of Students Secured ≥ 70 marks

Level 3: 75 % and above of Students Secured ≥ 70 marks

Target: Level 3

Subject Code/ Name: U19EET54 / Microprocessor and Microcontroller			**CAT 01**	≥ 70	**CAT 02**	**≥ 70**	**MODEL**	**≥ 70**
S.No.	**Register No.**	**Name of the student**						
1	19TE00xx	Student 1	12	N	14	N	57	N
2	19TE00xx	Student 2	78	Y	86	Y	83	Y
3	19TE00xx	Student 3	32	N	70	Y	48	N
4	19TE00xx	Student 4	72	Y	82	Y	75	Y
5	19TE00xx	Student 5	76	Y	80	Y	90	Y
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
34	19TE00xx	Student 34	76	Y	78	Y	78	Y
35	19TE00xx	Student 35	74	Y	78	Y	75	Y
36	19TE00xx	Student 36	70	Y	70	Y	83	Y
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
61	19TE00xx	Student 61	56	N	80	Y	89	Y
62	19TE00xx	Student 62	AB	N	38	N	51	N
NO. OF STUDENTS ATTAINED				45		50		51
ATTAINMENT PERCENTAGE				72.58		80.65		82.26
ATTAINMENT LEVEL				2		3		3

The analysis of Table III reveals that the attainment level for CAT 01 fell short of the expected target of Level 3, achieving only Level 2. In contrast, both CAT 02 and the model successfully met the anticipated target of Level 3. Consequently, the average attainment level was calculated to be 2.67, reflecting a minor shortfall from the overall target.

The attainment levels for the remaining courses will be evaluated and incorporated into the calculation of Course Outcome (CO) attainment. To address this shortfall and improve performance, corrective measures will be implemented in the forthcoming years. These measures will be designed to enhance future outcomes and ensure that upcoming assessments meet or exceed the established targets.

The analysis of Table IV shows that the attainment level for assignment has reached the expected target of level 3. Following this, the attainment levels for the remaining courses will be evaluated. The results from these evaluations will then be used to calculate the Course Outcome (CO) attainment, providing an overall measure of how well the course outcomes are being met across all assessments.

Table IV :
Assignment Attainment

Subject Code/ Name: U19EET54 / Microprocessor and Microcontroller

Level 1: 1 to 2 marks

Level 2: 3 to 4 marks **Target:** Level 3

Level 3: 5 marks

S. No.	Register No.	Name of the student	Marks
1	19TE00xx	Student 1	5
2	19TE00xx	Student 2	5
3	19TE00xx	Student 3	5
4	19TE00xx	Student 4	5
5	19TE00xx	Student 5	5
. . .	. . .	. . .	. . .
34	19TE00xx	Student 34	4
35	19TE00xx	Student 35	5
36	19TE00xx	Student 36	5
. . .	. . .	. . .	. . .
61	19TE00xx	Student 61	5
62	19TE00xx	Student 62	3

Attainment Level 1: 80 % and above of Students Secured ≥ Level 3

Attainment Level 2: 85 % and above of Students Secured ≥ Level 3

Attainment Level 3: 90 % and above of Students Secured ≥ Level 3

No. of Students Attained	62
Attainment percentage	91.53
Attainment level	3

The analysis of Table V shows that the attainment level for COCAT has reached the expected target of level 3. Following this, the attainment levels for the remaining courses will be evaluated. The results from these evaluations will then be used to calculate the Course Outcome (CO) attainment, providing an overall measure of how well the course outcomes are being met across all assessments.

Table V :
Cocat Attainment

Subject Code/ Name: U19EET54 / Microprocessor and Microcontroller

Level 1: 1 to 6 Marks

Level 2: 7 to 8 Marks

Target: Level 2

Level 3: 9 to 10 Marks

S. No.	Register No.	Name of the student	COCAT Marks	Attainment level	Target	Remarks
1	19TE00xx	Student 1	5	1	2	Not Attained
2	19TE00xx	Student 2	9	3	2	Attained
3	19TE00xx	Student 3	7	2	2	Attained
4	19TE00xx	Student 4	7	2	2	Attained
5	19TE00xx	Student 5	9	3	2	Attained
. . .	. . .	. . .	. . .	. . .	. . .	. . .
34	19TE00xx	Student 34	5	1	2	Not Attained
35	19TE00xx	Student 35	7	2	2	Attained
36	19TE00xx	Student 36	9	3	2	Attained
. . .	. . .	. . .	. . .	. . .	. . .	. . .
61	19TE00xx	Student 61	6	1	2	Not Attained
62	19TE00xx	Student 62	8	2	2	Attained

Attainment Level 1: 72 % and above of Students Secured ≥ Level 2

Attainment Level 2: 74 % and above of Students Secured ≥ Level 2

Attainment Level 3: 76 % and above of Students Secured ≥ Level 2

No. of students attained	**50**
Attainment percentage	**80.65**
Attainment level	**3**

The analysis of Table VI indicates that the attainment level for the end-semester examination has successfully reached the expected target of level 3. Subsequently, the attainment levels for the remaining courses will be assessed. The outcomes of these evaluations will be used to calculate the overall Course Outcome (CO) attainment, offering a comprehensive measure of how effectively the course objectives are being achieved across all assessments.

The above procedure is followed for all courses, and the attainment values calculated from the direct assessment methods are presented in Table VII for further analysis.

Based on the Target setting and students' performance from CAT / Model Examination, Assignment and COCAT (Course Outcome and Course Achievement Test), the average value of

Table VI :
End Semester Examination Attainment

Subject Code/ Name: U19EET54 / Microprocessor and Microcontroller

Level 1: 66% and above of Students Secured ≥ C grade

Level 2: 68% and above of Students Secured ≥ C grade **Target:** Level 3

Level 3: 70% and above of Students Secured ≥ C grade

S. No.	Register No.	Name of the student	Marks	Attainment level	Remarks
1	19TE00xx	Student 1	7	3	Attained
2	19TE00xx	Student 2	8	3	Attained
3	19TE00xx	Student 3	6	2	Not Attained
4	19TE00xx	Student 4	9	3	Attained
5	19TE00xx	Student 5	9	3	Attained
. . .	. . .	. . .	. . .	. . .	. . .
34	19TE00xx	Student 34	7	3	Attained
35	19TE00xx	Student 35	9	3	Attained
36	19TE00xx	Student 36	10	3	Attained
. . .	. . .	. . .	. . .	. . .	. . .
61	19TE00xx	Student 61	6	2	Not Attained
62	19TE00xx	Student 62	6	2	Not Attained

No. of students attained	**48**
Attainment percentage	**77.42**
Attainment level	**3**

Internal assessment is calculated. The external assessment is done based on Target setting and students' performance from University / End Semester Examination.

All course outcomes necessitate evaluation, measuring their respective levels of CO attainment. If the attainment of any CO's attainment fall short of the threshold requirement, then it is necessary to implement suitable teaching and learning strategies to improve CO attainment. Regular reviews and adjustments of the threshold values for different assessment methods are crucial for elevating expectations and targets to enhance overall quality.

Table VII :
Attainment Of Course Outcomes

Subject Code	Name of the Subject	Internal Assessment				20% of Internal Assessment (A)	External Assessment	80% of External Assessment (B)	Attainment (C=A+B)
		CAT / Model Examination	Assignment	COCAT	Average		University Examination		
U19BST101	Mathematics – I	2.67	3	3	2.89	0.58	3	2.4	2.98
U19BST102	Physics	3	3	3	3.00	0.60	3	2.4	3.00
U19BST103	Chemistry	3	3	3	3.00	0.60	3	2.4	3.00
U19BST110	Basic Civil and Mechanical Engineering	3	3	3	3.00	0.60	3	2.4	3.00
U19BST111	Engineering Mechanics	3	3	3	3.00	0.60	0	0	0.60
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EET33	Electromagnetic Theory	3	3	3	3.00	0.60	3	2.4	3.00
U19EET34	Electrical Machines – I	3	3	3	3.00	0.60	3	2.4	3.00
U19EET35	Electronic Devices and Circuits	3	3	2	2.67	0.53	3	2.4	2.93
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EET54	Microprocessor and Microcontroller	2.67	3	3	2.89	0.58	3	2.4	2.98
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEP81	Protection and Switchgear	3	3	-	3.00	0.60	3	2.4	3.00
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEW81	Project phase – II	3	3	-	3.00	0.60	3	2.4	3.00

Attainment of POs and PSOs (for each course) =

$$Value\ of\ PO1 - PO12\ \&\ PSO1 - PSO3\ from\ Table\ II \times \frac{Course\ Attainment\ value\ from\ Table\ VII}{Maximum\ correlation\ value\ 3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

The above procedure is repeated for all courses and the average value of direct attainment is calculated.

2. Indirect assessment

Indirect assessment measures the COs, POs and PSOs through the different surveys conducted by the department. These methods focus on gathering feedback from students and other stakeholders to assess perceptions of learning, rather than directly measuring student performance. The questions of survey forms have to be prepared to assess the course outcomes and program outcomes. Finally, program outcomes are determined by assessing the actual values of course outcomes, thereby establishing the level of achievement in relation to the program's goals. The indirect assessment methods are:

- Course exit survey
- Employer Survey
- Academic peers survey
- Parent survey
- Graduate exit survey
- Professional body survey
- Alumni survey
- Outreach and extension activities

These methods provide valuable insights into how students and other participants perceive their learning experiences, the effectiveness of the curriculum, and the overall quality of instruction. While indirect assessments do not directly measure knowledge or skills, they complement direct assessments by offering a broader understanding of how well the program's objectives and outcomes are being met.

Table VIII :
Alumni Survey Form

Level 1: ≤ 25 %

Level 2: 26 % - 50 %

Level 3: 51 % - 75 %

Level 4: 76 % - 100 %

Target: Level 3

S. No.	Register No.	Name of the Student	POs												PSOs		
			PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design / development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning	PSO1 Electrical knowledge to Face challenges	PSO2 Innovative research technologies	PSO3 Design/developments of industrial needs
1	xxxxxx01	Student 1	1	3	4	3	4	4	3	3	3	3	3	3	4	3	3
2	xxxxxx02	Student 2	1	3	3	3	4	3	4	3	3	3	2	3	3	2	3
3	xxxxxx03	Student 3	3	4	3	3	3	4	3	2	3	2	3	3	3	3	3
4	xxxxxx03	Student 4	3	4	2	2	3	3	3	3	3	3	3	3	3	3	2
5	xxxxxx04	Student 5	4	4	3	3	4	3	4	3	3	3	3	4	4	3	4
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
23	xxxxxx23	Student 23	4	3	3	4	3	3	3	4	3	3	4	3	2	2	2
24	xxxxxx24	Student 24	4	3	2	3	3	4	3	3	3	3	4	3	3	3	3
25	xxxxxx25	Student 25	3	3	4	2	4	3	3	4	4	3	4	3	4	3	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
42	xxxxxx42	Student 42	4	3	3	3	2	3	4	2	2	3	4	3	3	2	3
43	xxxxxx43	Student 43	3	3	3	4	3	4	3	2	3	4	4	3	4	3	2

Attainment Level 1: 60 % and above of Students Secured ≥ Level 3

Attainment Level 2: 70 % and above of Students Secured ≥ Level 3

Attainment Level 3: 80 % and above of Students Secured ≥ Level 3

No. of Students Attained	39	40	39	34	32	38	37	37	39	38	37	39	40	37	37
Attainment percentage	90.7	93.0	90.7	79.1	76.7	88.4	86.0	86.0	90.7	88.4	86.0	90.7	93.0	86.0	86.0
Attainment level	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Based on the feedback collected from the alumni, Table VIII has been formulated, and it has been observed that Program Outcome 4 (PO4) and Program Outcome 5 (PO5) have not met the performance targets established for this year. The target for these outcomes was set at Level 3, reflecting a high standard of achievement. However, it was found that some of these outcomes only reached Level 2, which is below the expected level of proficiency. This evaluation is comprehensive, applying to all courses within the program, and indicates that the shortfall is a widespread issue affecting multiple aspects of the curriculum.

To address these discrepancies, a range of corrective measures will be implemented in the upcoming academic year. These measures may include revising course content, enhancing

Table IX :
Graduate Exit Survey Form

Level 1: ≤ 25 %

Level 2: 26 % - 50 %

Level 3: 51 % - 75 %

Level 4: 76 % - 100 %

Target: Level 3

S. No.	Register No.	Name of the Student	POs												PSOs		
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	xxxxxx01	Student 1	4	2	2	3	2	4	3	4	3	4	3	3	4	2	4
2	xxxxxx02	Student 2	3	4	4	4	3	3	2	3	4	3	4	4	2	4	2
3	xxxxxx03	Student 3	2	3	3	4	4	4	3	3	4	4	3	4	3	4	4
4	xxxxxx03	Student 4	3	3	2	4	3	2	3	2	3	3	3	4	4	3	3
5	xxxxxx04	Student 5	4	3	2	4	2	3	3	4	3	2	3	3	4	3	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
23	xxxxxx23	Student 23	3	4	4	3	3	3	3	4	3	4	4	4	3	3	2
24	xxxxxx24	Student 24	4	3	4	4	4	3	4	3	4	3	3	4	3	3	2
25	xxxxxx25	Student 25	3	4	3	4	4	4	4	4	3	4	3	4	3	4	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
47	xxxxxx42	Student 47	3	4	4	4	4	3	4	3	2	4	4	2	4	3	3
48	xxxxxx43	Student 48	1	4	3	4	3	3	3	4	4	3	4	3	3	4	3

Attainment Level 1: 60 % and above of Students Secured ≥ Level 3

Attainment Level 2: 70 % and above of Students Secured ≥ Level 3

Attainment Level 3: 80 % and above of Students Secured ≥ Level 3

No. of Students Attained	44	42	44	42	41	35	37	40	43	43	44	40	44	42	34
Attainment percentage	91.67	87.50	91.67	87.50	85.42	72.92	77.08	83.33	89.58	89.58	91.67	83.33	91.67	87.5	70.83
Attainment level	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

instructional methods, providing additional student support, and refining assessment strategies. The goal of these interventions is to ensure that both PO4 and PO5 meet or exceed the Level 3 targets in the future, thereby improving overall program quality and aligning with the educational objectives set for the institution.

Based on the feedback collected from the graduates, Table IX has been formulated, and it has been observed that Program Outcome 6 (PO6), Program Outcome 7 (PO7), and Program Specific Outcome 3 (PSO3) have not met the performance targets set for this year. The targets for these outcomes were set at Level 3, which represents a higher standard of achievement. However, it has been found that some of these POs and PSO only reached Level 2, which is below the expected level of proficiency. This evaluation encompasses all courses within the program, indicating that the issue is widespread and affects various areas of the curriculum.

To address these deficiencies, corrective measures will be introduced in the upcoming academic year. These measures may include revising the curriculum, enhancing teaching methods, providing additional resources and support for students, and improving assessment practices. The objective is to ensure that PO6, PO7, and PSO3 meet the Level 3 targets, thereby aligning with the program's overall educational goals and improving student outcomes across all courses.

Based on the feedback collected from the students' parents, Table X has been formulated, and it has been observed that Program Outcome 4 (PO4) and Program Outcome 8 (PO8) have not met the performance targets set for this year. While the target for both outcomes was set at Level 3, which indicates a higher standard of proficiency, some of these POs only reached Level 2, falling short of the expected benchmark. This evaluation applies to all courses across the program, reflecting areas that require improvement in both knowledge application and skill development.

Table X :
Parent Survey Form

Level 1: ≤ 25 %

Level 2: 26 % - 50 %

Level 3: 51 % - 75 %

Level 4: 76 % - 100 %

Target: Level 3

S. No.	Name of the Parent	Qualification & Occupation	POs												PSOs		
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	Parent 1	EEE & xxxxxxxx company, Assistant manager	3	4	4	3	3	4	3	3	2	3	3	3	3	4	3
2	Parent 2	DME, xxxxxxxx company, Supervisor	2	2	3	3	4	3	3	3	4	4	3	3	3	4	4
3	Parent 3	B.Tech(EEE) & xxxxxxxx company, Engineer	3	3	3	3	3	3	3	3	3	4	3	2	3	2	4
4	Parent 4	B.E(ECE) & xxxxxxxx company - Quality engineer	3	3	3	3	4	3	3	2	3	3	4	4	4	2	4
5	Parent 5	B.Tech(EEE) & xxxxxxxx company, Maintenance engineer	4	3	3	3	3	3	3	2	3	4	3	3	3	3	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
23	Parent 23	M.Sc & xxxxxxxx company, Production incharge	4	4	3	4	4	4	3	3	4	3	4	3	2	3	2
24	Parent 24	M.Tech & xxxxxxxx company, Assistant manager	3	3	2	3	3	4	2	4	4	4	3	3	3	3	3
25	Parent 25	ITI & xxxxxxxx company, Commercial Inspector	4	3	3	2	2	3	4	4	3	3	4	3	3	4	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
41	Parent 41	B.E(ECE) & xxxxxxxx company, JTO	4	3	4	2	3	3	3	4	4	2	4	4	3	3	3
42	Parent 42	B.Tech(EEE) & xxxxxxxx company, JE	4	2	4	4	2	4	3	3	3	4	4	3	3	4	3

Attainment Level 1: 60 % and above of Students Secured ≥ Level 3

Attainment Level 2: 70 % and above of Students Secured ≥ Level 3

Attainment Level 3: 80 % and above of Students Secured ≥ Level 3

No. of Students Attained	39	38	39	33	37	38	37	32	38	38	37	38	37	36	38
Attainment percentage	92.9	90.5	92.9	78.6	88.1	90.5	88.1	76.2	90.5	90.5	88.1	90.5	88.1	85.7	90.5
Attainment level	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

To address these gaps, targeted corrective measures will be introduced in the upcoming academic year. These measures may include enhanced teaching strategies, revised course content, additional support for students, and focused assessments to better track progress. The goal is to ensure that by the end of the next cycle, PO4 and PO8 meet the desired Level 3 targets, thus aligning with the overall program objectives and improving the educational outcomes for all students involved.

Based on the feedback collected from the academic peers at the institutions where the graduates are pursuing their higher studies, Table XI has been formulated, and it has been observed that all Program Outcomes (POs) have successfully met the performance targets set for this year. This indicates that the educational objectives, competencies, and skill levels outlined for students have been achieved across the board. The survey evaluation, which encompasses data from all relevant courses within the program, demonstrates a consistent level of performance and alignment with the expected outcomes. This positive result highlights the effectiveness of the teaching methods, curriculum design, and student engagement strategies implemented throughout the academic year.

Table XI :
Academic Peers Survey Form

Level 1: ≤ 25 %

Level 2: 26 % - 50 %

Level 3: 51 % - 75 %

Level 4: 76 % - 100 %

Target: Level 3

S. No.	Name of the Faculty	Designation	POs												PSOs		
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	Faculty 1	Professor & Head, xxxxxxxx College	2	3	3	3	3	3	4	2	3	3	3	3	4	3	4
2	Faculty 2	Assistant Professor / xxxxxxxx University	3	3	3	3	3	2	4	3	4	4	4	2	4	4	3
3	Faculty 3	Professor / xxxxxxxx College	3	3	4	4	3	4	4	4	3	3	3	4	4	3	3
4	Faculty 4	Professor / xxxxxxxx College	3	4	3	3	4	3	3	3	4	4	3	3	4	4	3
5	Faculty 5	Professor / xxxxxxxx College	3	4	3	2	2	3	3	3	4	2	4	4	4	2	4
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
8	Faculty 8	Professor / xxxxxxxx College	4	4	2	3	3	4	4	4	4	3	4	4	3	4	3
9	Faculty 9	Professor / xxxxxxxx College	3	2	3	4	4	4	3	3	3	3	4	3	4	3	3
10	Faculty 10	Professor / xxxxxxxx College	3	2	2	2	3	4	3	3	3	3	2	3	4	4	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
15	Faculty 15	Assistant Professor / xxxxxxxx University	3	3	2	2	3	3	3	2	3	3	3	3	2	2	3
16	Faculty 16	Assistant Professor / xxxxxxxx University	3	4	3	3	3	2	3	3	3	4	3	3	2	3	2

Attainment Level 1: 60 % and above of Students Secured ≥ Level 3

Attainment Level 2: 70 % and above of Students Secured ≥ Level 3

Attainment Level 3: 80 % and above of Students Secured ≥ Level 3

No. of Students Attained	15	13	13	13	15	13	15	14	15	14	13	15	13	13	15
Attainment percentage	94	81	81.25	81.25	94	81	93.75	88	94	88	81.3	94	81.25	81.25	93.75
Attainment level	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Moving forward, these outcomes provide a strong foundation for maintaining and enhancing the quality of the program, ensuring that future targets can be met or exceeded in alignment with institutional goals.

Based on the feedback collected from employers at the organizations where the graduates are working, Table XII has been formulated, and it has been observed that certain Program Outcomes (POs), specifically PO4, PO5, and PO11, along with Program Specific Outcome (PSO2), have not met the performance targets established for this year. The target level set for these outcomes was Level 3, which indicates a higher level of proficiency or mastery. However, it was found that some of these POs and PSOs only reached Level 2, falling short of the desired benchmark.

This evaluation applies uniformly to all courses within the program, reflecting a need for improvement across multiple areas. In response to these findings, a series of corrective actions and strategic interventions will be introduced in the upcoming academic year. These measures will aim to enhance the performance of students and ensure that the established targets for all POs and PSOs are met or exceeded, thereby aligning the program outcomes with the overall educational goals of the institution.

Table XII :
Employer Survey Form

Level 1: ≤ 25 %
Level 2: 26 % - 50 %
Level 3: 51 % - 75 %
Level 4: 76 % - 100 %

Target: Level 3

S. No.	Name of the Company	POs												PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	xxxxxxxx company 1	3	2	3	2	3	3	3	2	4	3	3	3	4	4	4
2	xxxxxxxx company 2	4	4	3	3	4	3	4	4	4	4	4	2	4	3	3
3	xxxxxxxx company 3	2	4	3	4	4	4	3	3	4	3	4	3	3	2	4
4	xxxxxxxx company 4	3	3	3	3	3	3	3	3	2	4	3	3	3	3	4
5	xxxxxxxx company 5	3	3	4	3	2	3	4	3	4	4	4	3	3	3	3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
18	xxxxxxxx company 18	2	2	3	3	4	2	4	4	4	3	3	4	4	3	4
19	xxxxxxxx company 19	3	4	4	3	4	3	3	3	4	3	2	3	3	4	3
20	xxxxxxxx company 20	3	4	3	4	3	3	2	3	3	2	3	3	2	2	2
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
29	xxxxxxxx company 29	4	4	3	2	3	4	3	4	4	4	3	4	3	3	4
30	xxxxxxxx company 30	4	2	4	3	4	3	2	3	4	3	4	3	2	4	4

Attainment Level 1: 60 % and above of Students Secured ≥ Level 3
Attainment Level 2: 70 % and above of Students Secured ≥ Level 3
Attainment Level 3: 80 % and above of Students Secured ≥ Level 3

No. of Students Attained	28	27	26	25	25	27	26	26	26	26	25	26	26	25	28
Attainment percentage	88	84	81.25	78.125	78	84	81.25	81	81	81	78.1	81	81.25	78.13	87.5
Attainment level	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**

Table XIII :
Consolidated Indirect Survey

INDIRECT SURVEY	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Alumni Survey Form	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3
Graduate Exit Survey Form	3	3	3	3	3	2	2	3	3	3	3	3	3	3	2
Parent Survey Form	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3
Academic Peers Survey Form	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Employer Survey Form	3	3	3	2	2	3	3	3	3	3	2	3	3	2	3
Average	**3**	**3**	**3**	**2.4**	**2.6**	**2.8**	**2.8**	**2.8**	**3**	**3**	**2.8**	**3**	**3**	**2.8**	**2.8**

The consolidated results from the indirect survey are illustrated in Table XIII, which provides a visual representation of the overall performance. The table highlights specific areas where performance has fallen short of expectations, offering a detailed breakdown of the identified shortfalls.

In response to these findings, a comprehensive plan will be developed and implemented in the upcoming period. This plan will include targeted interventions and strategic adjustments aimed at addressing the areas of weakness. The goal is to enhance the achievement of the set targets and effectively address the gaps identified through this

survey. These measures will be carefully designed to improve performance and ensure that future evaluations reflect a higher level of success and alignment with our goals.

Attainment of POs and PSOs for Indirect survey =

$$Value\ of\ PO1-PO12\ \&\ PSO1-PSO3\ from\ Table\ II \times \frac{Average\ value\ \ from\ Table\ XIII}{Maximum\ correlation\ value\ 3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Table XIV :
Attainment Of Program Outcomes And Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
U19BST101	2.58	1.59	0.60	0.60	-	0.79	0.79	-	-	-	-	0.99	1.99	0.99	0.99
U19BST102	3	3	2.6	2.2	2.8	-	-	-	-	-	-	-	1.6	2	1.8
U19BST103	2	1	-	-	-	1	1	-	-	-	-	1	1.8	1	-
U19BST110	3	1.5	2.3	1.2	1.2	1.8	1.5	-	0.5	1	0.5	3	0.7	0.7	0.5
U19BST111	0.60	0.40	0.40	0.60	-	-	-	-	-	-	-	0.20	0.32	0.20	0.20
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EET33	3	3	3	2	1	-	-	-	-	-	-	-	3	2.4	2.4
U19EET34	2.8	2.6	2.4	-	1	-	-	-	-	-	-	1	3	3	2
U19EET35	2.25	2.64	2.44	2.73	1.95	-	-	-	-	-	-	0.98	1.95	2.93	2.93
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEP81	3	3	3	3	-	-	-	-	-	-	-	1	2.6	1.8	2.2
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
U19EEW81	2.6	2.6	2.6	1.4	0.4	0.8	1.2	1.2	3	3	1.6	1	2.4	2	2.2
Direct Attainment	2.5481	2.0361	1.8299	1.5020	1.3769	0.3246	0.2301	0.0915	0.5604	0.2038	0.1340	0.8524	1.9529	1.9131	2.0355
80% of Direct Attainment (A)	2.0385	1.6289	1.4639	1.2016	1.1015	0.2597	0.1841	0.0732	0.4483	0.1630	0.1072	0.6819	1.5623	1.5305	1.6284
Indirect Attainment	2.5943	2.0674	1.8611	1.2388	1.1940	0.3034	0.2157	0.0871	0.5604	0.2038	0.1251	0.8679	1.9779	1.8008	1.9151
20% of Indirect Attainment (B)	0.5189	0.4135	0.3722	0.2478	0.2388	0.0607	0.0431	0.0174	0.1121	0.0408	0.0250	0.1736	0.3956	0.3602	0.3830
Attainment C=A+B	**2.5574**	**2.0424**	**1.8361**	**1.4494**	**1.3403**	**0.3204**	**0.2272**	**0.0906**	**0.5604**	**0.2038**	**0.1322**	**0.8555**	**1.9579**	**1.8907**	**2.0114**

As per regulation, the final attainment of POs and PSOs are determined by combining 80% from Direct Attainment and 20% from Indirect Attainment (Indirect Surveys). This calculation method ensures a comprehensive assessment approach, incorporating both direct measurements of student performance related to the desired outcomes and indirect feedback obtained through surveys to gauge perceptions and broader impacts.

Final POs and PSOs attainment, C = 80% of Direct Attainment (A) + 20% of Indirect Attainment (B). The attainment of POs and PSOs are shown in Table XIV.

Considering all the program's courses, a comparable approach is employed to consolidate the final POs and PSOs attainment. Correspondingly, appropriate remedial measures like tutorials, guest lectures, seminars featuring industry experts, and

content beyond curricular activities can be devised to augment and fortify the program.

Impact analysis

- Attainment level can be improved based on the increased attainment percentage compared with target percentage marks.
- On an annual basis, higher targets are established for subsequent years to maintain a trend of continuous improvement.
- In cases where the set targets are not met, a thorough examination of the course particulars takes place within the department advisory committee, leading to the formulation of an action plan to meet the targets in the following years.

The consequence of POs and PSOs attainment for all courses will show the program results which are accomplished the fullest conceivable degree. The program outcomes which are remotely accomplished structures the reason for arranging of activity for continuous improvement in the ensuing years.

Table XV :
Po & Pso Attainment

Target Setting:
Level 1: 80% and above of CO-PO/CO-PSO correlation
Level 2: 85% and above of CO-PO/CO-PSO correlation
Level 3: 90% and above of CO-PO/CO-PSO correlation Target: Level 3

Category	Program Outcome (PO)												Program Specific Outcome (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Actual correlation of CO-PO and CO-PSO	2.5943	2.0674	1.8611	1.5485	1.3777	0.3251	0.2311	0.0933	0.5604	0.2038	0.1340	0.8679	1.9779	1.9294	2.0519
Overall Attainment	2.5574	2.0424	1.8361	1.4494	1.3403	0.3204	0.2272	0.0906	0.5604	0.2038	0.1322	0.8555	1.9579	1.8907	2.0114
Level of Attainment	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Table XV displays the overall attainment of Program Outcomes (POs) and Program Specific Outcomes (PSOs), indicating that all the targets set for these outcomes have been successfully achieved. This table provides a comprehensive overview of how well the POs and PSOs have been met, reflecting the complete fulfillment of the established performance goals. The successful attainment of these targets underscores the effectiveness of the current strategies and highlights the program's ability to meet its educational objectives.

However, if any of the targets are not achieved, necessary corrective actions will be implemented in the forthcoming year to address these shortcomings. Even when targets are met, continuous improvement in attainment should be demonstrated in subsequent years. This commitment to ongoing enhancement ensures that the program not only maintains its effectiveness but also strives for higher standards and better alignment with evolving educational goals.

Conclusion

The paper proposes a streamlined approach for evaluating the attainment of both course outcomes and program outcomes. It involves computing the attainment levels for Program Outcomes (POs) and Program Specific Outcomes (PSOs) and then comparing these values to predefined target attainment levels. For those POs and PSOs that fall below the set targets, action plans can be devised. The suggested approach computes the attainment on both the course and program levels. This also offers proof of mapping between course outcomes and program outcomes, underscoring the importance of program educational objectives. The practice of employing a high-quality benchmark as the threshold for evaluating the attainment of both COs and POs, whether through direct or indirect means, is a reasonable and recommended exercise. Enhanced attainment of course outcomes can be facilitated through diverse teaching approaches, learning

engagements, and corrective actions. As a result, outcome-based education plays a crucial role in gauging the degree of transformation in students, equipping them with universally applicable skills for societal benefit.

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