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ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE

OUTCOME BASED EDUCATION (OBE) MANUAL

Institute Vision

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

Institute Mission

- To achieve academic excellence through innovative teaching and learning process.
- To imbibe the research culture for addressing industry and societal needs.
- To inculcate social attitude through community engagement initiatives.
- To provide conducive environment for building the entrepreneurial skills.

INDEX

1. INTRODUCTOIN TO OUTCOME-BASED EDUCATION (OBE)

1.1 INTRODUCTION

Education plays a fundamental role in shaping individuals, economies, and societies. In today's fast-evolving world, traditional education models that focus on syllabus completion and theoretical knowledge are no longer sufficient. Modern education systems require a more structured and outcome-driven approach to ensure that graduates are equipped with relevant skills and knowledge. This necessity has led to the adoption of Outcome-Based Education (OBE), a learning framework that emphasizes achieving specific, measurable outcomes in terms of knowledge, skills, and attitudes.

OBE is a learner-centric approach that ensures students develop competencies that are directly applicable to real-world challenges. Unlike traditional methods, which primarily focus on rote memorization and standardized testing, OBE ensures that students understand concepts, develop critical thinking, enhance their problem-solving abilities, and gain practical skills that will help them in their professional and personal lives.

In India, OBE has gained significant importance due to the increasing demand for quality education, employable graduates, and globally competitive institutions. The government and regulatory bodies such as the National Board of Accreditation (NBA) and the National Assessment and Accreditation Council (NAAC) have played a vital role in integrating OBE into higher education institutions (HEIs). The National Education Policy (NEP) 2020 has further emphasized the importance of OBE, making it a crucial component of India's evolving education landscape.

1.2 OUTCOME-BASED EDUCATION (OBE): A PARADIGM SHIFT IN LEARNING

OBE represents a major paradigm shift from conventional teaching approaches. In a traditional education system, the focus is on what teachers teach, and students are expected to absorb the information through lectures, textbooks, and examinations. However, OBE focuses on:

- Clearly defined learning outcomes that students must achieve by the end of a course or program.
- Flexible learning methods that accommodate different learning styles and preferences.
- Continuous assessment and improvement to ensure students develop the required competencies.

OBE is structured around three core levels of outcomes:

1. **Program Educational Objectives (PEOs)** – These are broad statements that define what graduates are expected to achieve within a few years of completing their degree. They typically relate to career growth, professional development, and societal contributions.
2. **Program Outcomes (POs)** – These are specific skills and abilities that students must acquire upon graduation. They are aligned with industry requirements and global educational standards.

3. **Course Outcomes (COs)** – These are the learning outcomes for individual courses. Each course is designed to contribute to the achievement of program outcomes.

By aligning education with predefined learning outcomes, OBE ensures that students are job-ready, innovative, and capable of addressing real-world challenges.

1.3 ACCREDITATION AND ITS ROLE IN OBE IMPLEMENTATION

Accreditation is the process of evaluating and recognizing an institution or program based on predefined quality standards. It plays a crucial role in ensuring that higher education institutions maintain high academic standards and continuously improve their curriculum and teaching methods. In India, the two main accreditation bodies responsible for higher education are:

a) National Board of Accreditation (NBA)

- NBA primarily accredits technical and professional programs, such as engineering, management, and pharmacy courses.
- It follows Outcome-Based Accreditation (OBA), ensuring that institutions meet global education standards and focus on measurable student outcomes.
- NBA accreditation is aligned with the Washington Accord, which enables international recognition of degrees.

b) National Assessment and Accreditation Council (NAAC)

- NAAC assesses the overall quality of institutions, covering various disciplines beyond technical education.
- It evaluates parameters such as teaching-learning processes, research output, infrastructure, and governance.
- Institutions receive grades ranging from A++ to D, indicating their quality and performance.

Accreditation through these bodies ensures that institutions adhere to high academic standards, continuously improve their programs, and enhance student learning experiences.

1.4 BENEFITS OF OBE AND ACCREDITATION IN INDIA

The implementation of OBE and accreditation frameworks brings several advantages to students, educators, and institutions. Some of the key benefits include:

a) Enhanced Learning Quality

- OBE moves beyond memorization, emphasizing deep learning, conceptual understanding, and real-world application.
- Students engage in hands-on projects, case studies, and problem-solving activities that enhance their comprehension.

b) Industry Relevance and Employability

- Employers today seek graduates who possess critical thinking, teamwork, communication, and technical skills.

- OBE ensures that academic programs are aligned with industry expectations, making graduates more employable.
- Accreditation acts as a quality benchmark, ensuring that institutions produce competent professionals.

c) Continuous Improvement and Innovation

- Since OBE emphasizes measurable learning outcomes, institutions must regularly update their curriculum, teaching methods, and assessment strategies.
- Faculty members engage in continuous professional development, adopting modern pedagogical techniques.

d) Global Recognition and Student Mobility

- Accredited institutions gain international credibility, enabling students to pursue higher education abroad or seek employment in multinational companies.
- Programs accredited by NBA under the Washington Accord are recognized in several countries, offering global career opportunities.

e) Student-Centric Education

- OBE encourages self-learning, innovation, and creativity.
- Students take ownership of their education, allowing for personalized and flexible learning experiences.

1.5 CHALLENGES IN IMPLEMENTING OBE AND ACCREDITATION

Despite its numerous benefits, implementing OBE and achieving accreditation come with certain challenges:

a) Resistance to Change

- Traditional teaching methods are deeply ingrained in Indian education. Transitioning to OBE requires faculty training, mindset shifts, and curriculum restructuring.

b) Resource Constraints

- Many institutions lack the necessary infrastructure, funding, and skilled educators required for OBE implementation.

c) Effective Assessment Methods

- Evaluating higher-order skills such as critical thinking, problem-solving, and creativity is more complex than traditional examinations.
- Institutions need robust assessment frameworks to measure learning outcomes effectively.

d) Standardization across Institutions

- India has a diverse range of educational institutions, from premier institutes like IITs and IIMs to smaller private colleges.
- Ensuring uniform OBE adoption and maintaining consistent quality standards across all institutions is a challenge.

1.6 SUMMARY

The shift towards Outcome-Based Education (OBE) and accreditation marks a significant transformation in India's higher education landscape. By focusing on learning outcomes, industry alignment, and continuous improvement, OBE ensures that students develop the necessary skills to succeed in the modern workforce. Accreditation by NBA and NAAC further strengthens the credibility of institutions, fostering global recognition and career opportunities for graduates.

Despite challenges, the adoption of OBE is crucial for India's long-term educational development. The implementation of NEP 2020, along with accreditation reforms, will play a pivotal role in enhancing education quality and making Indian graduates globally competitive. Institutions must actively embrace innovative teaching methodologies, modern assessment techniques, and continuous improvement strategies to fully leverage the benefits of OBE.

As India moves forward in its educational journey, the collaborative efforts of policymakers, educators, industry stakeholders, and students will be key in ensuring a world-class education system driven by quality, innovation, and measurable outcomes.

2. VISION, MISSION & QUALITY POLICY OF INSTITUTE

2.1 ABOUT THE INSTITUTE

Zeal College of Engineering & Research, Pune, established in 2007, offers a diverse range of academic programs. The institute provides Ten Undergraduate Programs in Civil Engineering, Computer Engineering, Electrical Engineering, Electronics & Telecommunication Engineering, Artificial Intelligence & Data Science (AIDS), Artificial Intelligence & Machine Learning (AIML), Robotics & Automation Engineering, Mechanical Engineering, Information Technology, and Electronics & Computer Engineering. Additionally, it offers Five Postgraduate Programs, an MBA Program, and PhD Research Centers in Mechanical Engineering and Electronics & Telecommunication Engineering.

The institute has been accredited with an 'A' grade in Cycle 1 (2017) and an 'A+' grade in Cycle 2 (2023). It is also ISO 21001:2018 (EOMS) certified. Zeal College has been granted Autonomous status for 10 years, conferred by the University Grants Commission (UGC) and approved by Savitribai Phule Pune University, effective from the academic year 2024-2025.

2.2 INSTITUTE VISION & MISSION

Vision	To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.
Mission	**M1**: To achieve academic excellence through innovative teaching and learning process. **M2**: To imbibe the research culture for addressing industry and societal needs. **M3**: To inculcate social attitude through community engagement initiatives. **M4**: To provide conducive environment for building the entrepreneurial skills.

3. QUALITY POLICY

At Zeal College of Engineering & Research, we are committed to delivering quality engineering education through continuous improvement in teaching, learning, evaluation, research, and holistic student development.

Zeal College of Engineering and Research has been awarded ISO 21001:2018 (EOMS) in 22-06-2022 which will be valid upto 21-06-2025.

The **Institute EOMS Policy** is as follows :

Zeal Education Society (ZES) is committed to a culture of redefining excellence and quality enhancement through a process of continuous quality improvement in all our endeavors comprises teaching- learning, research, intellectual property, consultancy, and continuing education in order to development of well competent and resilient professionals and remain focused in incubation and promotion of entrepreneurial spirit, eventually contributing substantially to nation-building.

3. PROGRAM OUTCOMES, PSO AND PEO

3.1 PROGRAM OUTCOMES – GRADUATE ATTRIBUTES

PO No.	Program Outcomes (POs)
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning is informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a

	member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3.2 PROGRAM SPECIFIC OUTCOMES (PSO) –(MECHANICAL ENGINEERING)

These qualities are expected, a student is able to do at the time of graduation. The PSOs are program specific. PSOs are defined by the department offering the program. There usually are two to four PSOs for a department. For example, the Program Specific Outcomes for Department of Mechanical Engineering is given below:

PSO No.	Program Specific Outcomes Statement
PSO1	Identify, formulate and analyze real-life mechanical engineering problems by applying the principles of thermal, design, manufacturing, interdisciplinary and allied engineering.
PSO2	Select and apply appropriate materials, metallurgical processes, measurement techniques, feedback control systems, hydraulic and pneumatic control systems to develop appropriate solutions to mechanical engineering problems.
PSO3	Select and apply appropriate manufacturing technologies and tools, and develop competencies for working in manufacturing and allied industries.
PSO4	Apply acquired knowledge, skills, and hands-on experiences to work professionally in mechanical and related systems.

3.3 PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

While designing Program Educational Objectives (PEOs), it is essential to prepare students for diverse career paths, including higher education, industry roles, and entrepreneurship. Key considerations include:

1. **Career Readiness** – Equip students for advanced studies, research, global/local industry roles, or entrepreneurial ventures with a strong technical foundation.
2. **Core Competencies** – Foster problem-solving, analytical thinking, and practical application skills through hands-on learning and interdisciplinary exposure.
3. **Knowledge Breadth** – Ensure a comprehensive curriculum that integrates emerging technologies, research insights, and industry trends.
4. **Professional Skills** – Develop effective communication, teamwork, leadership, and ethical values to navigate dynamic work environments.
5. **Supportive Learning Environment** – Provide modern infrastructure, industry collaborations, mentorship, and experiential learning opportunities to enhance student growth.

Well-structured PEOs ensure graduates are skilled, adaptable, and ethically responsible, empowering them to excel in their careers and contribute to society.

PEO No	Program Educational Objectives (PEOs)
PEO1	Mechanical Engineering graduates excel in solving industrial challenges, innovating for society, and leveraging core engineering principles for industry advancement
PEO2	Graduates will apply technical expertise, leadership, and entrepreneurship, to establish ethical organizations to address societal needs and pursue higher studies.
PEO3	Graduates will work effectively as individuals and as team members with high ethical values and motivation for life-long learning for the benefit of society.

3.4 METHOD FOR DEFINING COURSE OUTCOMES (COS)

As institute is affiliated to Savitribai Phule Pune University**,** the Board of Studies formulates Course Outcomes (COs) during syllabus revisions. COs are retained upon agreement between the domain coordinator and course faculty**.** Any modifications must align with Bloom's Taxonomy Levels and be validated by the domain coordinator**.**

4. BLOOMS TAXANOMY LEARNING

4.1 INTRODUCTION

Benjamin Bloom with his team developed a classification of levels of intellectual behavior important in learning. This became a taxonomy, including three overlapping domains: the cognitive, psychomotor and affective. Bloom's taxonomy is most often used when designing educational, training, and learning processes. The three domains of learning:

1) Knowledge and intellectual skills
2) Affective: growth in feelings or emotional areas (attitude or self)
3) Psychomotor: manual or physical skills

From the point of designing educational training cognitive domain of learning is required to be focused as it is predominated in majority of courses. The six levels of intellectual skills identified as per revised Bloom's taxonomy:

1) Remember: Recalling specific facts, definitions
2) Understand: Grasp the meaning of facts, definitions, concepts.
3) Apply: Use the concepts to solve problems.
4) Analyze: Break information into component parts, make inference.
5) Evaluate: Judge the value of information.
6) Create: Produce new ideas/processes.

4.2 ACTION VERBS

Choice of action verbs in constructing assessment questions is important to consider. Quite often, the action verbs are indicators of the complexity (level) of the question. Over time, educators have come up with a taxonomy of measurable verbs corresponding to each of the Bloom's cognitive levels. These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level we are trying to assess.

Suggestive list of skills/ competencies to be demonstrated at each of the Bloom's level and corresponding cues/ verbs for the examination/ test questions is given below:

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	• Ability to recall of information like facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • Ability to recall methodology and procedures, abstractions, principles, and theories in the field • Knowledge of dates, events, places • Mastery of subject matter	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where

2. Understand	• Understanding information • Grasp meaning • Translate knowledge into new context • Interpret facts, compare, contrast • Order, group, infer causes • Predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss
3. Apply	• Use information • Use methods, concepts, laws, theories in new situations • Solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyse	• Break down a complex problem into parts • Identify the relationships and interaction between the different parts of a complex problem • Identify the missing information, sometimes the redundant information and the contradictory information, if any	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select
5. Evaluate	• Compare and discriminate between ideas • Assess value of theories, presentations • Make choices based on reasoned argument • Verify value of evidence • Recognize subjectivity • Use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	• Use old ideas to create new ones • Combine parts to make (new) whole, • Generalize from given facts • Relate knowledge from several areas • Predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

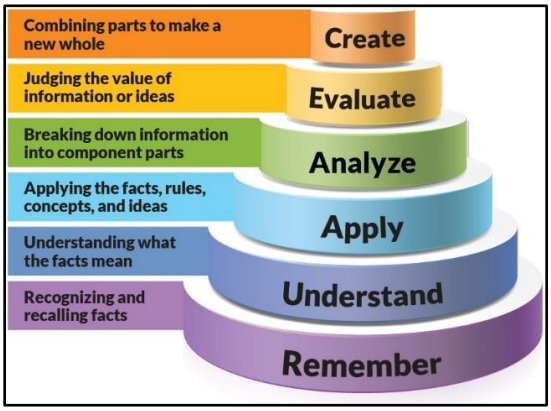

Figure: Blooms Taxanomy Levels

5. OBE FRAMEWORK DESIGN

The Outcome-Based Education (OBE) Framework at Zeal College of Engineering & Research is structured to ensure a systematic, measurable, and continuous improvement-driven approach to education. The framework aligns with NBA, NAAC, and SPPU guidelines, focusing on achieving Program Outcomes (POs), Program-Specific Outcomes (PSOs), and Course Outcomes (COs) through well-defined teaching, learning, and assessment strategies.

5.1 COMPONENTS OF THE OBE FRAMEWORK

A. Vision and Mission Alignment

- Define the Institution's Vision and Mission to set the foundation for learning goals.
- Align program objectives with national and international accreditation standards.

B. Program Educational Objectives (PEOs)

- Define long-term career and professional achievements expected from graduates (within 3-5 years post-graduation).
- PEOs should focus on higher studies, industry roles, entrepreneurship, and societal contributions.

C. Program Outcomes (POs) and Program-Specific Outcomes (PSOs)

- **POs (Graduate Attributes):** Defined by NBA and SPPU, covering knowledge, problem-solving, communication, ethics, and lifelong learning.
- **PSOs:** Specific to each department, ensuring students develop expertise in their respective domains.

D. Course Outcomes (COs)

- Each course defines 4-6 measurable COs that align with POs and PSOs.
- COs are framed using Bloom's Taxonomy to ensure different cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).

5.2 OBE IMPLEMENTATION PROCESS

A. Curriculum Design & Mapping

- **CO-PO-PSO Mapping:** Each course outcome (CO) is mapped to relevant POs and PSOs.
- Curriculum includes core courses, electives, skill-based courses, and industry-focused training.
- Incorporation of interdisciplinary learning, research, and innovation to align with industry demands.

B. Teaching-Learning Strategies

- **Student-Centric Pedagogy:** Includes project-based learning, case studies, industry exposure, and ICT-enabled teaching.

- **Experiential Learning:** Hands-on training, virtual labs, internships, and real-world problem-solving.
- **Soft Skills & Ethical Training:** Developing communication, teamwork, and ethical responsibility.

C. Assessment & Evaluation

- **Direct Assessment:**

  Direct Assessment tools includes internal assessment and external assessment tools. Internal Assessment is done through quizzes, assignments, class test etc. External Assessment is done through University examinations such In sem, endsem examination, TW/OR/PR examinations etc.

- **Indirect Assessment:**

  Course Exit Survey: At the end of each semester the course exit surveys are conducted for all the courses completed in the respective semester.

5.3 OBE ATTAINMENT & CONTINUOUS IMPROVEMENT

A. Attainment Calculation

- COs are evaluated through formative and summative assessments.
- COs contribute to POs and PSOs, and their attainment is measured quantitatively.

B. Data-Driven Decision Making

- Analysis of student performance to identify gaps in learning outcomes.
- Action plans implemented for curriculum enhancement, faculty development, and learning resource improvement.

C. Stakeholder Engagement

- Industry collaborations, alumni mentoring, and employer feedback to refine course content.
- Regular faculty training programs to adopt best teaching practices.

5.4 SUPPORT SYSTEM FOR OBE IMPLEMENTATION

A. Academic Monitoring

- PAQIC and DAB to oversee framework execution and compliance.
- Department Coordinators for monitoring CO-PO-PSO attainment.

B. Research & Innovation Support

- Centers of Excellence to promote R&D in emerging technologies.
- Startup and Entrepreneurship Cell to encourage innovation.

C. Infrastructure & Learning Resources

- Smart classrooms, digital libraries, and ICT-enabled learning.
- Industry-Institute partnerships for real-world exposure.

The OBE Framework at Zeal College of Engineering & Research ensures an outcome-driven approach to academic excellence, skill development, and professional growth. By fostering a structured learning process, industry relevance, and continuous improvement, the institution aims to produce competent, innovative, and socially responsible engineers.

6. OBE IMPLEMENTATION

The Outcome-Based Education (OBE) Implementation Structure at Zeal College of Engineering & Research is designed to ensure systematic curriculum planning, effective teaching-learning processes, and continuous assessment to achieve the desired Program Outcomes (POs), Program-Specific Outcomes (PSOs), and Course Outcomes (COs) as per university guidelines.

6.1 GOVERNANCE AND LEADERSHIP

- **Institute Academic Coordinator & IQAC (Internal Quality Assurance Cell):** Oversees OBE implementation and ensures continuous quality improvement.
- **PAQIC :** Defines policies, monitors execution, and provides training on OBE methodologies.
- **Department Academic Coordinators:** Responsible for executing OBE at the departmental level, aligning curriculum with POs and PSOs.

6.2 CURRICULUM DESIGN & MAPPING

- **Alignment with Graduate Attributes:** Ensuring that COs contribute to POs and PSOs as prescribed by Savitribai Phule Pune University (SPPU) and NBA guidelines.
- **Bloom's Taxonomy Integration:** Defining measurable COs using action-oriented verbs at different cognitive levels.
- **Curriculum Enhancement:** Incorporating industry-relevant content, skill development programs, and multidisciplinary courses.

6.3 TEACHING-LEARNING PROCESS

- **Student-Centric Approach:** Implementation of active learning methods, including project-based learning, problem-solving sessions, and flipped classrooms.
- **ICT-Enabled Teaching:** Use of LMS, virtual labs, and online resources for interactive learning.
- **Industry Exposure:** Guest lectures, industry visits, and internships to bridge the industry-academia gap.
- **Skill Development & Employability Training:** Conducting workshops on technical and soft skills to enhance job readiness.

6.4 ATTAINMENT ANALYSIS & CONTINUOUS IMPROVEMENT

- **CO-PO Mapping & Attainment Calculation:** Using assessment data to evaluate how well course outcomes contribute to program outcomes.
- **Action Plan for Improvement:**
    - Identifying gaps in attainment and implementing corrective actions.
    - Faculty training programs and curriculum revisions to enhance learning effectiveness.

- **Periodic Review & Accreditation Readiness:** Ensuring compliance with NBA, NAAC, and university regulations for continuous enhancement.

6.5 RESEARCH, INNOVATION & ENTREPRENEURSHIP SUPPORT

- **Encouraging Research & Publications:** Promoting faculty and student participation in research projects, patents, and conferences.
- **Startup & Entrepreneurship Development:** Providing incubation support, mentorship, and funding opportunities for student-led startups.
- **Interdisciplinary Innovation Labs:** Establishing labs for AI, IoT, Robotics, and emerging technologies to foster innovation.

6.6 STAKEHOLDER ENGAGEMENT & INSTITUTIONAL GROWTH

- **Industry Collaborations:** MoUs with companies for internships, training, and joint research projects.
- **Alumni Involvement:** Leveraging alumni network for mentorship and career guidance.
- **Social Responsibility & Sustainability:** Encouraging community outreach, eco-friendly initiatives, and ethical engineering practices.

The structured OBE framework at Zeal College of Engineering & Research ensures a holistic, student-centric approach that fosters academic excellence, professional competency, and lifelong learning. Through continuous assessment, industry integration, and innovative teaching methodologies, the college is committed to producing competent engineers and future leaders.

7. METHODS TO BRIDGE CURRICULUM GAPS

Curriculum gaps may arise due to rapid technological advancements, evolving industry demands, accreditation requirements, or the need for interdisciplinary skills. To ensure students are well-prepared for industry, research, and entrepreneurship, the following strategies are implemented to bridge curriculum gaps effectively.

7.1 INDUSTRY-ACADEMIA COLLABORATION

- **Guest Lectures & Expert Talks:** Industry professionals and subject matter experts conduct sessions on emerging technologies.
- **Industry Visits & Internships:** Students gain practical exposure through real-world industry experiences.
- **Memorandums of Understanding (MoUs):** Collaborations with industries help integrate industry-specific topics into the curriculum.

7.2 VALUE-ADDED COURSES & CERTIFICATIONS

- **Professional Certification Programs:** Courses like Python, AI-ML, IoT, Cloud Computing, Cybersecurity, and Data Science provide additional skills.
- **Skill-Based Training:** Short-term courses aligned with industry needs enhance employability.

7.3 PROJECT-BASED & EXPERIENTIAL LEARNING

- **Live Industry Projects:** Students work on industry problems to gain hands-on experience.
- **Capstone Projects:** Final-year students develop innovative solutions based on real-world challenges.
- **Hackathons & Technical Competitions:** Encourage problem-solving, innovation, and interdisciplinary learning.

7.4 FACULTY DEVELOPMENT & TRAINING

- **Workshops & Seminars:** Faculty members undergo training on advanced teaching methodologies.
- **Industrial Training for Faculty:** Enhances awareness of industry expectations and helps update course content accordingly.

7.5 RESEARCH & INNOVATION INITIATIVES

- **Centers of Excellence:** Specialized labs for Manufacturing, Automobile, IoT, Robotics, etc. foster research.
- **Encouraging Patents & Publications:** Faculty and students are motivated to file patents and publish research papers.

7.6 SOFT SKILLS & PERSONALITY DEVELOPMENT

- **Communication & Leadership Training:** Enhancing professional skills for global employability.
- **Mock Interviews & Resume Building:** Preparing students for placement and higher education opportunities.

- **Entrepreneurship Development Programs:** Encouraging students to start their ventures through incubation support.

7.7 CURRICULUM REVISION & CONTINUOUS IMPROVEMENT

- **Feedback Mechanism:** Inputs from students, alumni, employers, and industry experts are analyzed to identify gaps.
- **Outcome-Based Education (OBE) Implementation:** Regular CO-PO-PSO attainment analysis ensures curriculum effectiveness.
- **Interdisciplinary Electives:** Courses that integrate knowledge from multiple domains to broaden student perspectives.

By adopting a structured and dynamic approach to bridge curriculum gaps, Zeal College of Engineering & Research ensures students are equipped with industry-relevant knowledge, technical skills, and professional competencies. These initiatives help in creating future-ready graduates who can excel in their careers, research, and entrepreneurship.

8. ATTAINMENT OF COURSE OUTCOMES (COs), PROGRAM OUTCOMES (POs) AND PROGRAM-SPECIFIC OUTCOMES (PSOs)

The attainment of Course Outcomes (COs), Program Outcomes (POs), and Program-Specific Outcomes (PSOs) is a crucial part of Outcome-Based Education (OBE). The process involves systematic assessment, analysis, and continuous improvement to ensure students acquire the necessary knowledge, skills, and competencies.

8.1 CO ATTAINMENT PROCESS

As per institute academic process manual, the attainment of course outcomes is carried out using process steps given in following table 8.1.

Table 8.1: CO Attainment Process

Sr. No.	Activity	Responsibility
01	Savitribai Phule Pune University - Board of Studies of respective programs have framed COs of courses while revisions and finalizing the syllabus. These COs are retained if domain coordinator and course faculty are convinced/agreed.	Course Faculty/ Domain Coordinator
02	If there is a need to modify course outcomes, Bloom Taxonomy Levels should be followed by course faculty. The domain coordinator shall confirm the same.	Course Faculty
03	The course outcomes are disseminated to students through course notes, website, lab manuals, ERP and during teaching learning process.	Course Faculty
04	Course outcomes are mapped with Program Outcomes (POs) at three levels of relevance as; (a) Slight (Low) : 1; (b) Moderate (Medium) : 2; (c) Substantial (High) : 3.	Course Faculty
05	The Direct and Indirect assessment tools are used for determining the CO-PO attainment. The weightage for direct and indirect assessment tools are set to 90% and 10% respectively.	Course Faculty
06	Direct Assessment Tools are again sub-classified as internal and external assessment tools. The weightage for internal and external assessment tools are set to 30% and 70% respectively. The target for internal assessment tools are set.	Course Faculty
07	The target for external assessment tools are set.	HOD, Domain coordinator, academic coordinator
08	The assessment results are filled in CO-PO-PSO attainment calculation excel sheet.	Course Faculty
09	The assessment tools are mapped with concerned course outcomes. Percentage CO attainment and CO attainment level is obtained.	Course Faculty

10	The CO attainment is compared with the set target. If it is less than set target, then attainment analysis report should be submitted to domain coordinator and HOD.	Course Faculty
11	CO-PO-PSO mapping is filled in excel sheet. And PO-PSO attainment is obtained.	Course Faculty
12	Course wise CO attainment (%) and Level summary is prepared.	Academic Coordinator

The details of the assessment tools used for evaluating attainment of course outcomes is shown in following table 8.2.

Table 8.2: Assessment tool for measuring Course Outcome Attainment

<table>
<tr><th>Assessment Method</th><th colspan="2">Assessment Tool</th><th>Process for Data Collection</th></tr>
<tr><td rowspan="8">Direct Method (90%)</td><td rowspan="5">University Examination (70 %)</td><td>In-Semester Examination</td><td>University level examination and evaluation of the answer sheets.</td></tr>
<tr><td>End-Semester Examination</td><td>University level examination and evaluation of the answer sheets.</td></tr>
<tr><td>Practical Examination</td><td rowspan="3">Evaluation of the term work, practical examination, oral examination, and the score of the students out of 25/50/100 depending on the individual courses.</td></tr>
<tr><td>External Oral Examination</td></tr>
<tr><td>Term work, Project Presentation, Seminar presentation</td></tr>
<tr><td rowspan="3">Internal Assessment (30%)</td><td>Class Tests 1 and 2</td><td>Examination and evaluation of the answer sheets by the Course in-charge.</td></tr>
<tr><td>Assignments</td><td>Evaluation of the assignments by the Course in-charge.</td></tr>
<tr><td>Laboratory Performance</td><td>Continuous Evaluation and assessment of the Laboratory Performance by the Course in-charge.</td></tr>
<tr><td>Indirect Method (10%)</td><td colspan="2">Course Exit Survey</td><td>Collecting the responses from the students about their understanding of the course. This survey is conducted at the end of every semester.</td></tr>
</table>

Direct Assessment Tools:

The assessment of course outcomes (COs) is evaluated using direct assessment tools, which include internal and external assessments. Internal assessment contributes 30% and external assessment contributes 70% to the overall assessment of course outcomes.

Internal Assessment:

In order to evaluate the attainment of course outcomes of theory courses, class tests and assignments are used as effective assessment tools. Each course is divided into six units, which is evaluated through 2 class tests. Class test 1 covers the first two units and class test 2 covers the remaining four units. Also assignments are given, to evaluate all course outcomes of each course. The questions in these assessments are designed in accordance with Blooms Taxonomy and are mapped to the specific course outcomes (COs) of the course.

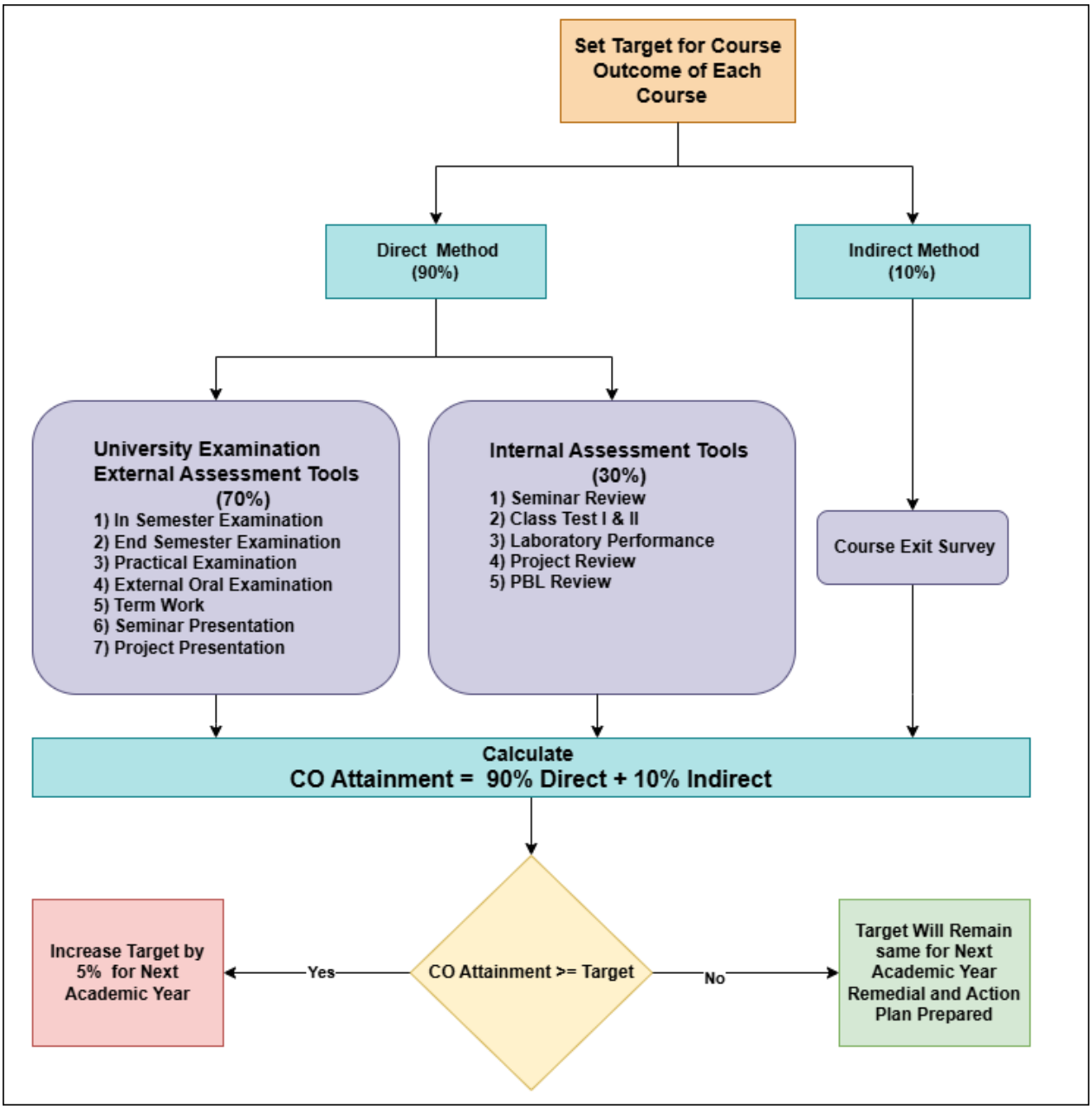

Figure 8.1: CO Attainment Calculation Process

In order to evaluate the attainment of course outcomes of lab courses laboratory performances in accordance with course outcomes of lab courses are used as internal assessment tools.
For courses like Seminar, Internship, Project Based Learning and Project, performance reviews are used as an internal assessment tool.

External Assessment:

The university conducts in-semester and end-semester examinations to evaluate students' performance in theory courses and oral, practicals and term work for seminar, internship, project and lab courses. The university declared results of these examinations are used as external assessment tools.

Indirect Assessment Tool:

Course Exit Survey: At the end of each semester the course exit surveys are conducted for all the courses completed in the respective semester. The course exit surveys are well-designed and focused on relevant and meaningful questions covering all the course outcomes. The results of these surveys are used as an indirect assessment tool.

8.2 RECORD THE ATTAINMENT OF COURSE OUTCOME OF ALL COURSES WITH RESPECT TO SET ATTAINMENT LEVELS

Attainment Levels

The minimum target percentage of marks to calculate CO attainment is decided based on difficulty level of the courses. Furthermore, following table 8.3 also highlights the attainment level for the courses.

Table 8.3: Range of Marks and its attainment level.

Range of Marks (%)	Attainment Level
Less than 50 %	No attainment
50 to Less than 60 %	1
60 to Less than 70 %	2
70 % and above	3

For each academic year (i. e. AY 2020-21, 2021-22 and 2022-23), the minimum target marks are decided based on the attainment achieved for the previous year. If the target of CO attainment is achieved in the previous year, then the target marks are increased for current year and if not, it is kept same as that of the previous year. The reasons are identified for the courses whose COs are not attended and further action plans are prepared.
Attainment levels for Course Outcomes (COs) are a measure of students achievement in meeting the course objectives. These levels are assessed using a variety of tools, and the attainment level may be stated as a percentage of students expected to achieve a certain threshold of marks. The attainment level is then measured as the actual percentage of students who meet or exceed the set threshold. The defined attainment levels are;

Attainment Level 0: Less than 50% students scoring more than target percentage of marks out of the relevant maximum marks.

Attainment Level 1: 50% to less than 60% students scoring more than target percentage of marks out of the relevant maximum marks.

Attainment Level 2: 60% to less than 70% students scoring more than target percentage marks out of the relevant maximum marks.

Attainment Level 3: More than 70% students scoring more than target percentage marks out of the relevant maximum marks.

On the basis of results from assessment tools, the attainment levels are decided based on the details mentioned in above Table 8.3.

Mapping of Assessment Tools and Course Outcomes

Mapping assessment tools and COs is an important part of the assessment process and can help to ensure that student performance is evaluated consistently and effectively. Mapping of assessment tools and course outcomes (COs) involves identifying which assessment tools are appropriate for evaluating specific COs. This process ensures that the assessment tools align with the intended learning outcomes and measure the desired knowledge, skills, and abilities.

This process also helps to ensure that the assessment methods are valid and reliable, and that they provide accurate and meaningful information about student learning.

CO attainment calculations for Industrial Engineering (C402049B) course based on used assessment tools (Batch 2019-23) is shown in tables from Table 8.4 to Table 8.8.

Table 8.4 : Weightage of Assessment type

Assessment type	% weightage
Direct	90
External	70
Internal	30
Indirect	10

Table 8.5: Minimum Marks (%) Target based on the difficulty levels

	Attainment Level	Category of Attainment	% students	% Marks
Target Setting	-	No attainment	0	75
	1	Low	50	75
	2	Medium	60	75
	3	High	70	75

Table 8.6: Mapping of COs with assessment tools

CO Mapping			CO1	CO2	CO3	CO4	CO5	CO6
Direct Attainment	**Internal Assessment Tools**	Assignment 1	Y					
		Assignment 2		Y				
		Assignment 3			Y			
		Assignment 4				Y		
		Assignment 5					Y	
		Assignment 6						Y
		Class Test 1	Y	Y				
		Class Test 2			Y	Y	Y	Y

	External Assessment Tools	Theory	Y	Y	Y	Y	Y	Y
Indirect Attainment	**End of Course Survey**	ECS Q 1	Y					
		ECS Q 2		Y				
		ECS Q 3			Y			
		ECS Q 4				Y		
		ECS Q 5					Y	
		ECS Q 6						Y

Note: Y indicates assessment tool is linked with course outcome

Table 8.7: CO Attainment Percentage calculations for Direct and Indirect Assessment Tools

% CO Attainment			**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Direct Attainment	**Internal Assessment Tools**	Assignment 1	100.00					
		Assignment 2		100.00				
		Assignment 3			100.00			
		Assignment 4				100.00		
		Assignment 5					100.00	
		Assignment 6						100.00
		Class Test 1	85.23	80.65				
		Class Test 2			60.32	75.17	75.19	85.91
		Internal Attainment	92.62	90.32	80.16	87.58	87.59	92.95
	External Assessment Tools	Theory	54.97	54.97	54.97	54.97	54.97	54.97
		External Attainment	54.97	54.97	54.97	54.97	54.97	54.97
	Direct Attainment		66.26	65.57	62.52	64.75	64.76	66.36
Indirect Attainment	**End of Course Survey**	ECS Q 1	100.00					
		ECS Q 2		100.00				
		ECS Q 3			100.00			
		ECS Q 4				100.00		
		ECS Q 5					100.00	
		ECS Q 6						100.00
Indirect Attainment			100.00	100.00	100.00	100.00	100.00	100.00
Final % CO Attainment			66.26	65.57	62.52	64.75	64.76	66.36

Table 8.8: CO Attainment Level calculations for Direct and Indirect Assessment Tools

CO Attainment Level			CO1	CO2	CO3	CO4	CO5	CO6
Direct Attainment	Internal Assessment Tools	Assignment1	3.00					
		Assignment2		3.00				
		Assignment3			3.00			
		Assignment4				3.00		
		Assignment5					3.00	
		Assignment6						3.00
		Class Test 1	3.00	3.00				
		Class Test 2			2.03	3.00	3.00	3.00
		Internal Attainment	3.00	3.00	2.52	3.00	3.00	3.00
	External Assessment Tools	Theory	1.50	1.50	1.50	1.50	1.50	1.50
		External Attainment	1.50	1.50	1.50	1.50	1.50	1.50
	Direct Attainment		1.95	1.95	1.80	1.95	1.95	1.95
Indirect Attainment	End of Course Survey	ECS Q 1	3.00					
		ECS Q 2		3.00				
		ECS Q 3			3.00			
		ECS Q 4				3.00		
		ECS Q 5					3.00	
		ECS Q 6						3.00
	Indirect Attainment		3.00	3.00	3.00	3.00	3.00	3.00
Final CO Attainment Level			2.63	2.56	2.25	2.48	2.48	2.64

As per the institute academic process manual, the attainment of program outcomes (POs) and program specific outcomes (PSOs) is carried out using process steps given in following table.

Table 8.9: PO-PSO Attainment Process

Sr. No.	Activity	Responsibility
01	The POs and PSOs attainment target is set by the institute based on the direct assessment and indirect assessment.	Principal, IQAC
02	For overall attainment of each POs and PSOs, 80 % weightage is given to direct assessment and 20 % weightage is given to indirect assessment.	Principal, IQAC
03	The Target of PO/PSO for the admitted batch 2020-21 is set as follows: PO1 to PO5 – 55 % (1.65) PO6 to PO12 – 50 % (1.5) PSOs – 55 % (1.65)	Principal, IQAC
04	If the PO/PSO attainment of the present batch is not attained, then target of the next batch is retained as previously defined targets. Observations should be noted and corrective actions should be planned to achieve targets.	PAQIC, Head of Department

05	If the PO/PSO attainment of the present batch is attained, then target of the next batch is incremented additionally by 5% of the set previous targets.	PAQIC, Head of Department

The assessment tools and processes used for measuring the attainment of Program Outcomes (POs) and Program Specific Outcomes (PSOs) are summarized in following Table 8.10.

Table 8.10: Assessment tools and processes for attainment of the POs and PSOs

Assessment Method	Source for Data Collection	Frequency/ Data Collection
Direct Method (80% of average POs attainment by direct method)	Average attainment of Course Outcomes	Once in a Semester
Indirect Method (20% of overall attainment of POs by indirect method))	Program exit surveys Extra-curricular and Co-curricular activities	Once in a year
	Employer surveys	Regular
	Alumni surveys	Regular
	Extra-curricular and Co-curricular activities	Regular

Direct Assessment: Direct assessment of POs and PSOs is based on the attainment of Course Outcomes (COs), where COs are mapped to POs and PSOs.

Indirect Assessment: Indirect assessment of POs and PSOs is conducted through surveys and extra-curricular and co- curricular activities. The surveys include program exit survey, employer survey, and alumni survey. The extra-curricular and co- curricular activities include event participation, site visits, guest/ expert lectures, alumni interactions, Student training programs/Hands on training programs/ Workshops and Student Association/Chapter Activities etc.

8.3 CO, PO AND PSO ATTAINMENT CALCULATION

The assessment tools and processes used for measuring the attainment of Program Outcomes (POs) and Program Specific Outcomes (PSOs) are summarized in Table 8.11.

Table 8.11: Assessment tools and processes for attainment of the POs and PSOs

Assessment Method	Source for Data Collection	Frequency/ Data Collection
Direct Method (100% of average POs attainment by direct method)	Average attainment of Course Outcomes	Once in a Semester

Direct Assessment: Direct assessment of POs and PSOs is based on the attainment of Course Outcomes (COs), where COs are mapped to POs and PSOs.

POs Attainment:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
107001	1.3	1.22	1.3	1.3	1.26	1.55	PO7	PO8	PO9	PO10	PO11	PO12
107002	1.54	1.55	1.3	1.04	1.48	PO6	1.05	PO8	1.55	PO10	PO11	PO12
101007	3	3	3	2	2	2	2	3	2	3	2	1
101011	1.38	1.34	1.5	1.46	1.3	PO6	1.5	PO8	1.46	1.46	1.46	1.46
101014	2.5	PO2	PO3	3	PO5	3	3	2	2	PO10	2	PO12
102003	1.53	1.49	1.5	1.55	1.6	1.52	1.73	PO8	PO9	PO10	PO11	PO12
102012	1.71	PO2	1.8	PO4	1.9	PO6	PO7	PO8	1.31	1.37	PO11	PO12
103004	1.33	1.34	1.6	1.63	1.33	PO6	0.96	1.63	PO9	1.05	PO11	PO12
104010	1.28	1.12	1.1	1.12	1.12	1.33	1.58	PO8	1.22	1.42	0.99	PO12
107008	1.62	1.61	1.7	1.64	1.65	1.65	1.65	PO8	1.65	PO10	1.65	PO12
107009	1.32	1.36	1.3	1.32	1.47	PO6	1.25	PO8	PO9	PO10	PO11	PO12
110005	1.74	1.64	1.6	1.23	1.16	PO6	PO7	1.04	1.04	1.22	PO11	PO12
110013	1.8	3	3	2	3	2	3	2	1.8	2	2	2
111006	2.43	2.43	PO3	PO4	2.82	2.85	PO7	PO8	PO9	PO10	PO11	PO12

PO Attainment Level

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Direct Attainment	1.75	1.76	1.72	1.61	1.70	1.99	1.77	1.93	1.56	1.65	1.68	1.49
CO Attainment	1.75	1.76	1.72	1.61	1.70	1.99	1.77	1.93	1.56	1.65	1.68	1.49

PSOs Attainment:

Course	PSO1	PSO2	PSO3	PSO4
1010073	2	2	3	2
101011	1.62	1.01	1.53	1.12
101014	2.5	PSO2	PSO3	1.5
102003	1.53	1.53	1.55	1.45
102012	1.89	PSO2	1.24	PSO4
103004	1.11	0.55	PSO3	PSO4
104010	1.58	1.08	0.83	0.53
107001	1.22	1.53	1.07	PSO4
107002	1.04	1.13	1.55	1.29
107008	1.01	1.61	1.1	0.55
107009	1.56	1.3	PSO3	PSO4
110005	1.68	1.33	1.55	1.22
110013	2.7	3	PSO3	3
111006	1.43	PSO2	2.15	PSO4

PSO Attainment Level

Course	PSO1	PSO2	PSO3	PSO4
Direct Attainment	1.63	1.46	1.56	1.41
CO Attainment	1.63	1.46	1.56	1.41

CONCLUSION

Outcome-Based Education (OBE) is a student-centered approach that has gained popularity in higher education institutions due to its ability to improve student outcomes and institutional effectiveness. Implementing OBE can be challenging, but with the right tools and strategies, institutions can successfully transition to this new approach.