**DR. D.Y. PATIL PRATISTHAN'S COLLEGEOF ENGINEERING SALOKHENAGAR, KOLHAPUR**

# Outcome Based Education (OBE) Manual

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# PREFACE

## A Journey Toward Educational Excellence

The pursuit of quality education is fundamental to institutional success and societal progress. At Dr. D. Y. Patil Pratisthan's College of Engineering, we recognize that excellence in engineering education requires more than delivering content—it demands a systematic, evidence-based approach to ensuring that every graduate develops the competencies required for professional success.

Outcome-Based Education (OBE) represents this commitment. Rather than asking "What content should we teach?", OBE asks the more fundamental question: "What should our graduates be able to do?" This shift in perspective transforms education from input-focused to outcome-focused, making our accountability tangible, measurable, and continuous.

## Purpose of This Manual

This comprehensive OBE Manual serves as the operational guide for implementing Outcome-Based Education across all engineering programs at Dr. D. Y. Patil Pratisthan's College of Engineering. It provides:

- **Conceptual Foundation:** Understanding the philosophy and framework of OBE
- **Practical Guidance:** Step-by-step processes for outcome design, teaching, and assessment
- **Implementation Tools:** Templates, matrices, and calculation methods
- **Quality Assurance:** Systematic approaches to monitoring and continuous improvement
- **Institutional Standards:** Consistent application across all programs and departments

## Who Should Use This Manual?

This manual is essential reading for: - **Faculty Members:** Course designers, instructors, and program coordinators - **Department Heads:** Program leadership and quality oversight - **PAQIC Members:** Program Assessment and Quality Improvement Committees - **IQAC Coordinators:** Institutional Quality Assurance Cell members - **Students:** Understanding their learning journey and program expectations - **Administrators:** Supporting implementation and resource allocation - **Accreditation Bodies:** NBA, NAAC reviewers assessing institutional quality

## Key Principles Guiding This Manual

**1. Backward Design:** Curriculum begins with clearly defined outcomes, not content coverage.

**2. Alignment:** All educational activities—teaching, assessment, and support—align systematically toward outcome achievement.

**3. Evidence-Based Practice:** Decisions are grounded in assessment data and evidence, not tradition or assumption.

**4. Continuous Improvement:** Assessment data drives perpetual enhancement, not accountability or blame.

**5. Transparency:** Learning expectations, assessment methods, and results are clearly communicated to all stakeholders.

**6. Student-Centric Focus:** All initiatives prioritize student learning and competency development.

## Organization of This Manual

This manual is organized into four comprehensive sections:

**SECTION 1: FUNDAMENTALS** provides the conceptual foundation, including institutional vision/mission, OBE framework principles, and hierarchical outcome structure.

**SECTION 2: OUTCOME SPECIFICATIONS** defines what students should achieve, detailing Program Outcomes, Program Specific Outcomes, and Course Outcomes with comprehensive guidance on design and articulation.

**SECTION 3: TEACHING AND LEARNING** describes pedagogical approaches and classroom practices that facilitate outcome achievement, emphasizing student-centric and active learning methods.

**SECTION 4: ASSESSMENT AND EVALUATION** outlines comprehensive assessment methods, calculation processes, and continuous improvement cycles for measuring and enhancing outcome attainment.

An additional chapter addresses emerging technologies and AI tools supporting OBE implementation.

## Expected Outcomes of OBE Implementation

By systematically implementing the guidance in this manual, our institution aims to:

- Ensure all graduates achieve 11 Program Outcomes and discipline-specific competencies
- Improve student learning through targeted instruction aligned to outcomes
- Enhance employer satisfaction with graduate capabilities
- Strengthen accreditation standing with NBA, NAAC, and ABET
- Foster continuous improvement culture across the institution
- Increase graduate success in professional practice and career advancement

## A Commitment to Excellence

The development and implementation of this manual represent our institutional commitment to educational excellence. It reflects extensive consultation with faculty, students, employers, alumni, and accreditation bodies. More importantly, it translates

our Vision and Mission into concrete, measurable actions.

We recognize that OBE implementation is a journey, not a destination. This manual provides the roadmap. Success depends on the dedication of our faculty to student learning, the engagement of students in their educational journey, and the commitment of all stakeholders to continuous improvement.

We invite all readers to embrace the principles and practices outlined in this manual, contribute to their refinement, and join us in our mission to produce engineering graduates who are technically excellent, ethically responsible, and professionally prepared to address the challenges of our time.

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# CHAPTER 1: DEFINITIONS

**Outcome Based Education (OBE)** is an academic approach and systematic framework that focuses on developing and accessing specified outcomes (Knowledge, Skills, and Attitude) that students are expected to achieve by the time of graduation.

**Vision** is the long-term aspiration and strategic direction of the institution describing where we want to be.

**Mission** is the statement describing how we will achieve our vision through specific institutional commitments and values.

**Programme Educational Objectives (PEOs)** describe the career and professional developments of graduates, which are to be assessed after 3 to 5 years of graduation.

**Programme Outcomes (POs)** explain the Knowledge, Skills and Attitude that the students are expected to attain upon graduation.

**Program Specific Outcomes (PSOs)** are discipline-specific competencies that extend and specialize the generic Program Outcomes within the context of a particular engineering discipline or program.

**Course Outcomes (COs)** outline the course specifications to be acquired by students and describe what students will know, understand and be able to perform as a result of learning experiences in a course.

**Knowledge and Attitude Profile (WK)** describe the essential knowledge domains and professional attitudes that serve as the foundation for achieving Program Outcomes in engineering education.

**Knowledge, Skills and Attitude (KSA)** are the three types of behavior elements, also known as educational activities that are selected from Bloom's taxonomy to develop comprehensive student competencies.

**Continuous Internal Evaluation (CIE)** is an in-house assessment tool to measure the achievement of COs and POs through tests, assignments, quizzes, and practical work conducted during the semester.

**Course End Survey** (Indirect method) is a technique to measure the attainment of COs and POs indirectly from student perception and feedback on course outcomes at the end of the semester.

**Direct Method** is a technique to measure the attainment of COs and POs directly from demonstrated student performance in external examinations (university exams) and internal components (CIE, practicals, projects).

**Indirect Method** is a technique to measure the attainment of COs and POs indirectly through surveys and feedback from stakeholders including students, alumni, employers, and industry experts.

**Attainment** refers to the measurable degree or extent to which students have achieved specified learning outcomes, expressed as a percentage or performance level.

**Assessment Tools** are instruments and methods used to collect evidence of student learning, including written exams, practical work, projects, assignments, presentations, and surveys aligned to course outcomes.

**Rubric** is a detailed scoring guide specifying criteria and performance levels for assessing student work consistently and aligned to course outcomes.

**Bloom's Taxonomy** is a hierarchical framework for classifying learning objectives into six cognitive levels: Remember, Understand, Apply, Analyze, Evaluate, and Create.

**Action Verbs** are observable, measurable verbs used to write learning outcomes that clearly indicate what students must demonstrate (e.g., explain, apply, analyze, design, create).

**SMART Outcomes** is a framework for developing well-written outcomes that are Specific, Measurable, Achievable, Realistic, and Time-bound.

**Articulation Matrix** is a table that systematically maps how each Course Outcome contributes to Program Outcomes and Program Specific Outcomes using correlation levels (3=High, 2=Medium, 1=Low, -=No correlation).

**CO-PO Mapping** is the process of linking course outcomes to program outcomes to show how each course contributes to program-level goals.

**Gap Analysis** is the process of identifying differences between target attainment and actual attainment, investigating root causes, and developing improvement strategies.

**Action Plan** is a documented strategy specifying concrete steps, responsible parties, timelines, resources, and success metrics for addressing identified gaps in outcome attainment.

**Continuous Improvement** is an ongoing, systematic process of assessing learning outcomes, analyzing results, identifying gaps, and implementing targeted enhancements to educational programs.

**Program Assessment and Quality Improvement Committee (PAQIC)** is a departmental committee responsible for program-level assessment planning, data analysis, gap identification, and coordinating continuous improvement initiatives.

**Internal Quality Assurance Cell (IQAC)** is the institutional-level quality assurance body responsible for overall OBE implementation, accreditation compliance, and

institutional quality monitoring.

**Target Attainment** is the expected level of outcome achievement established before instruction begins, serving as the benchmark for comparing actual attainment with desired performance.

**Attainment Level** is a performance rating indicating the extent of outcome achievement. At Dr. D. Y. Patil Pratisthan's College of Engineering: - Level 3.0: 76-100% students achieve >50% marks (Excellent) - Level 2.0: 56-75% students achieve >50% marks (Satisfactory) - Level 1.0: 40-55% students achieve >50% marks (Needs Improvement) - Below 1.0: <40% students achieve >50% marks (Unsatisfactory)

**PO Attainment Threshold** at our institution is 1.50. Program Outcomes with attainment below 1.50 are flagged as requiring immediate improvement attention.

**Survey** is a structured instrument used for indirect assessment to collect feedback from stakeholders (students, alumni, employers, industry experts) on program quality, graduate competencies, and learning effectiveness.

# CHAPTER 2: VISION AND MISSION

## 2.1 Vision of the Institute

**To strive & become centre of excellence in Higher Education & be a preferred choice of Institution by the students.**

The vision statement reflects the institution's long-term aspiration to achieve excellence in engineering education and become the preferred destination for students seeking quality technical education. This vision emphasizes both academic rigor and student-centric approach, establishing the foundation for all institutional initiatives including the implementation of Outcome Based Education.

## 2.2 Mission of the Institute

The mission of Dr. D. Y. Patil Pratisthan's College of Engineering comprises four integrated statements that operationalize the vision:

### M1 – To nurture a culture of excellence in teaching & learning with active involvement of stakeholders.

This mission statement commits the institution to fostering an environment where both teaching and learning are conducted with excellence. It emphasizes the importance of involving all stakeholders—faculty, students, parents, alumni, employers, and industry partners—in the educational process. Active stakeholder involvement ensures that the curriculum remains relevant, responsive, and aligned with societal and industry needs.

### M2 – To provide quality technical education with focus on fundamentals and hence become a preferred educational institute in this region.

This mission focuses on delivering quality engineering education with strong emphasis on foundational concepts. By ensuring students develop deep understanding of engineering fundamentals, the institution prepares them for lifelong learning and adaptability to emerging technologies. This commitment to fundamental knowledge creates a competitive advantage and positions the college as a preferred choice in the region.

### M3 – To encourage students participation in academics, co-curricular and extracurricular activities for their overall personality development and they emerge as innovators, leaders and entrepreneurs.

This mission recognizes that engineering education encompasses more than technical knowledge. It emphasizes holistic student development through diverse learning experiences—academic, co-curricular, and extracurricular. The goal is to develop graduates who are not only technically competent but also possess leadership qualities,

innovation mindset, and entrepreneurial capabilities to drive organizational and societal progress.

### M4 – To promote sustainable practices with ethical values.

This mission commits the institution to integrating sustainability and ethics into all educational activities and institutional operations. It reflects the responsibility of engineering education to address global challenges including environmental sustainability, resource conservation, and sustainable development. Ethical values ensure that graduates practice professional integrity and fulfill their responsibilities to society.

## 2.3 Departmental Vision and Mission

### Computer Science and Engineering (CSE) Department

**Vision of Programme:** To produce competent computer professionals having strong fundamental knowledge, technical skills and work ethics.

**Mission of Programme:** -

- ✓ To promote growth of an individual by imparting comprehensive prerequisite knowledge using latest tools and technologies.
- ✓ To inculcate professionalism, social awareness and promote creativity by mentoring the students.
- ✓ To establish industry institute interaction to enable student to cater to ever changing industry demands and to nurture entrepreneurial qualities. - To provide state-of-the-art environment and opportunities for soft skill and professional skill development.

### Computer Science and Engineering (Data Science) Department

**Vision of Programme:** To become a pioneer department in the field of computer science & engineering with a specialization in the data science domain with a focus to produce professional & socially responsible engineers.

**Mission of Programme:** -

- ✓ To adopt the best practices for outcome-based learning.
- ✓ To enable the graduates to use modern tools to design and develop data science-based applications.
- ✓ To ensure the responsible use of data to benefit society.

## Civil Engineering Department

**Vision of Programme:** To produce competent civil engineers having strong fundamental knowledge, technical skills work ethics and to accept global challenges.

**Mission of Programme:**

- ✓ To inculcate quality and real time education through conducive teaching learning environment.
- ✓ To promote creativity, excellence, discipline and social and environmental concern.
- ✓ To explore career opportunities for the students and enhance industry-institute interaction.
- ✓ To prepare our students to be the technical, business and global leaders of tomorrow by inculcating technical and managerial work skills.

## Electrical Engineering Department

**Vision of Programme:** Promote excellence in the field of Electrical Engineering and allied areas through quality education and research to develop globally competent electrical engineers to serve future needs and challenges of the society.

**Mission of Programme:**

- ✓ To adopt the best practices for teaching & learning to address local & global needs of electrical domain.
- ✓ To incorporate academics, research in the domain of electrical engineering to develop solutions for societal problems.
- ✓ To inculcate professional & leadership skills, cultural & environmental awareness with an urge for lifelong learning.

# 2.4 Integration of Vision and Mission with OBE Implementation

The Vision and Mission statements of both the institution and individual departments guide all aspects of OBE implementation:

**Curriculum Development:** Program Outcomes and Course Outcomes are designed to align with and support the achievement of mission objectives.

**Teaching and Learning:** Instructional methods, learning activities, and assessment strategies are selected to foster the values and competencies articulated in the vision and mission.

**Quality Assurance:** Regular assessment and continuous improvement processes ensure that educational outcomes contribute to achieving institutional and departmental missions.

**Stakeholder Communication:** The vision and mission are communicated to all stakeholders to ensure shared understanding and commitment to institutional goals.

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# CHAPTER 3: OUTCOME-BASED EDUCATION FRAMEWORK

## 3.1 What is the OBE Framework?

The Outcome Based Education (OBE) Framework is the conceptual and operational structure that Dr. D. Y. Patil Pratisthan's College of Engineering uses to organize, design, and deliver engineering education. It is based on the principle that all educational activities—from institutional planning to daily classroom instruction—should be systematically aligned toward the achievement of clearly defined learning outcomes.

## 3.2 The OBE Pyramid: Hierarchical Alignment

The foundation of our OBE framework is the pyramid model, which represents the hierarchical relationship between different levels of outcomes and organizational goals. The pyramid shows how specific course-level learning contributes to broader program and institutional goals.

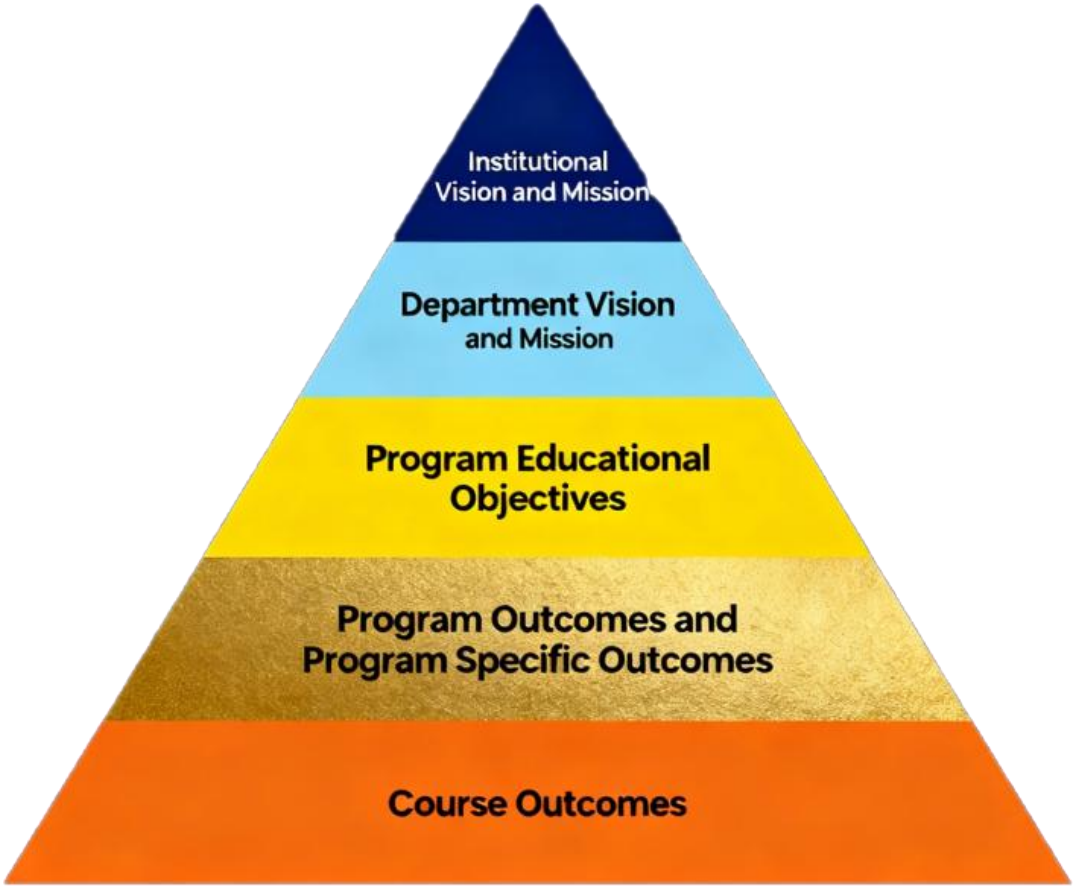


**Figure 3.1: OBE Pyramid - From Course Outcomes to Institutional Vision**

### Reading the Pyramid (From Basement to Apex):

**Basement Level: Course Outcomes (COs)** - Most specific and detailed level - Individual course-level learning targets - Directly assessed through course assessments - Foundation supporting all higher levels - Example: "Apply Python libraries to analyze a dataset"

**Second Level: Program Outcomes (POs) and Program Specific Outcomes (PSOs)** - Program Outcomes: 11 generic engineering competencies all graduates must achieve - Program Specific Outcomes: Discipline-specific competencies unique to each engineering field - Built upon and supported by course outcomes across the curriculum - Assessed through multiple courses and comprehensive evaluation

**Third Level: Program Educational Objectives (PEOs)** - Medium-term career goals for graduates (3-5 years post-graduation) - Represent the professional impact of the program - Aligned with institutional mission - Assessed through alumni surveys and career tracking

**Fourth Level: Department Vision and Mission** - Specific departmental aspirations and values - Operationalize institutional goals within disciplinary context - Guide department-level decision-making and improvements

**Apex Level: Institutional Vision and Mission** - Highest level aspirations of the institution - "Centre of excellence in Higher Education" - Guide all activities across the institution - Represent fundamental values and long-term direction

### How the Pyramid Works - Dual Direction Alignment:

**Upward Contribution:** When students achieve Course Outcomes across multiple courses → they achieve Program Outcomes and Specific Outcomes → which prepare them to achieve PEOs → fulfilling departmental and institutional missions → realizing institutional vision.

**Downward Guidance:** Institutional Vision and Mission → define PEOs → shape Program Outcomes and Specific Outcomes → operationalize through Course Outcomes → guide daily classroom activities.

## 3.3 The OBE Framework Components

The OBE framework comprises several interconnected components working together to ensure systematic alignment and continuous improvement:

### Component 1: Outcome Definition

- Clear articulation of outcomes at all levels (PEOs, POs, PSOs, COs)
- Alignment between levels ensuring consistency
- Annual review and refinement based on data

### Component 2: Curriculum Design

- Backward design: starting with outcomes, then designing curriculum
- Ensuring every course contributes to program outcomes
- Systematic coverage of all outcomes across the program

### Component 3: Teaching and Learning

- Student-centric instructional methods
- Diverse pedagogical approaches (project-based, problem-based, etc.)
- Alignment of teaching to outcomes

### Component 4: Assessment and Evaluation

- Direct assessment: measuring actual student performance (80% weightage)
- Indirect assessment: collecting stakeholder feedback (20% weightage)
- Comprehensive evaluation across all outcomes

### Component 5: Data Analysis and Gap Identification

- Systematic compilation and analysis of attainment data
- Comparison of actual vs. target achievement
- Investigation of root causes when targets are not met

### Component 6: Continuous Improvement

- Development of action plans to address gaps
- Implementation of curriculum and pedagogical improvements
- Monitoring effectiveness of improvements

### Component 7: Documentation and Reporting

- Faculty record books maintaining course and outcome information
- Departmental assessment reports
- Institutional quality assurance reporting to accreditation bodies

## 3.4 OBE Implementation Cycle

The OBE framework operates through a continuous cycle of planning, implementation, assessment, and improvement that repeats annually.


**Figure 3.2: OBE Implementation Cycle**

### The Seven Phases:

**Phase 1 – PLAN (June-July):** Review prior year's attainment data. Define or refine outcomes for upcoming year. Design curriculum and select teaching methods. Develop assessment tools. Set targets for student achievement. Prepare faculty and resources.

**Phase 2 – DESIGN (July-August):** Faculty finalize course syllabi aligned to outcomes. Develop teaching plans and lesson structures. Prepare assessment rubrics and scoring guides. Communicate expectations to students. Arrange resources and materials needed.

**Phase 3 – TEACH (August-May):** Deliver instruction using student-centric methods aligned to outcomes. Provide formative feedback to students during semester. Identify students needing additional support. Conduct unit-wise assessments and mid-semester reviews. Adjust teaching based on student progress.

**Phase 4 – ASSESS (May-June):** Administer course assessments (CIE, practicals, projects, university exams). Conduct indirect assessments (surveys, feedback). Score using outcome-aligned rubrics. Compile attainment data for each outcome.

**Phase 5 – ANALYZE (June):** Calculate attainment levels for all course outcomes. Aggregate to program outcome levels. Compare actual vs. target attainment. Identify outcomes with attainment below targets. Investigate root causes of gaps.

**Phase 6 – IMPROVE (July-August):** Develop action plans for below-target outcomes. Identify specific interventions needed. Plan curriculum modifications or teaching improvements. Allocate resources for improvements. Communicate action plans to faculty.

**Phase 7 – SUSTAIN (Ongoing):** Document improvements implemented. Monitor effectiveness of changes. Share best practices across faculty. Maintain improvements for consistency. Prepare for next cycle of planning.

## 3.5 Key Principles of the OBE Framework

### Principle 1: Backward Design

Curriculum development begins with clearly defined outcomes, NOT with content coverage. The question is "What do students need to be able to do?" not "What content must we teach?"

### Principle 2: Systematic Alignment

All components—outcomes, curriculum, instruction, and assessment—are deliberately aligned. Misalignment weakens the framework's effectiveness.

### Principle 3: Evidence-Based Practice

Decisions about curriculum, teaching, and resource allocation are based on attainment data and evidence, not on tradition, preference, or assumption.

### Principle 4: Transparency and Communication

Learning expectations, assessment methods, and performance results are clearly

communicated to students, faculty, parents, and employers.

### Principle 5: Continuous Improvement Mindset

Assessment is not conducted to assign blame or compliance, but to identify improvement opportunities. Data is used to enhance learning continuously.

### Principle 6: Student-Centric Focus

All activities prioritize student learning and development of competencies. Teaching methods are selected to best enable outcome achievement.

### Principle 7: Shared Responsibility

OBE success requires commitment and participation from faculty, students, administrators, support staff, and external stakeholders (alumni, employers, industry partners).

## 3.6 OBE Framework Structure at Our Institution

Our OBE framework is implemented through a clear organizational structure:

### Institutional Level:

- IQAC (Internal Quality Assurance Cell) oversees overall framework implementation
- Academic Council approves policies and major decisions
- Principal provides leadership and resource support

### Departmental Level:

- Department Head ensures department compliance with framework
- PAQIC (Program Assessment and Quality Improvement Committee) conducts program-level assessment and improvement
- Faculty implement outcomes in their courses

### Course Level:

- Individual faculty design and teach to course outcomes
- Faculty conduct assessments aligned to outcomes
- Faculty contribute data to program-level analysis

### Student Level:

- Students receive clear communication of learning expectations
- Students are assessed on achievement of outcomes
- Students receive feedback supporting their learning

## 3.7 How OBE Differs from Traditional Education

| Aspect | Traditional Approach | OBE Framework |
|---|---|---|
| **Starting Point** | "What content must we cover?" | "What should students be able to do?" |
| **Curriculum** | Content-driven | Outcome-driven (backward |

| Aspect | Traditional Approach | OBE Framework |
|---|---|---|
| **Design** | | design) |
| **Teaching Role** | Content delivery | Facilitator of learning and competency development |
| **Learning Focus** | Content mastery | Competency and capability development |
| **Assessment** | Primarily summative | Formative and summative |
| **Assessment Purpose** | Grade assignment | Learning improvement |
| **Success Measure** | Completion of content | Achievement of outcomes |
| **Accountability** | Compliance with mandates | Demonstration of student learning |
| **Improvement** | Occasional updates | Continuous, data-driven improvement |

## 3.8 Benefits of the OBE Framework

### For Students:

- Clear understanding of what they are expected to learn
- Focused learning experiences aligned to career readiness
- Regular feedback supporting their development
- Preparation for professional practice and lifelong learning

### For Faculty:

- Clear guidance on curriculum design and teaching priorities
- Data showing the effectiveness of their instruction
- Opportunities for professional development and innovation
- Recognition of successful practices

### For Employers:

- Graduates who possess defined, measurable competencies
- Clear communication about graduate capabilities
- Opportunity for input on curriculum relevance
- Workforce prepared for contemporary practice

### For the Institution:

- Demonstrated educational effectiveness for accreditation
- Evidence-based accountability
- Continuous improvement toward excellence
- Alignment of all activities toward common goals
- Institutional reputation and standing

### For Society:

- Engineers prepared with technical and ethical competencies
- Graduates contributing to sustainable development

- Professional responsibility and accountability
- Solutions to complex societal challenges

## 3.9 Our Commitment to the OBE Framework

Dr. D. Y. Patil Pratisthan's College of Engineering is committed to:

- Systematic implementation of OBE across all four engineering programs
- Regular training and support for faculty in OBE methodology
- Transparent communication of outcomes and assessment results
- Data-driven continuous improvement
- Alignment with national and international accreditation standards
- Excellence in engineering education and graduate preparation

# CHAPTER 4: PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

## 4.1 Definition

Programme Educational Objectives (PEOs) describe the career and professional developments of graduates, which are to be assessed after 3 to 5 years of graduation.

## 4.2 Characteristics of PEOs

- Career-focused (what graduates achieve in their profession)
- Aligned with institutional Mission
- Broad enough to accommodate diverse career paths
- Measurable through alumni surveys and employer feedback
- Typically 2-4 per program
- Stable but reviewed periodically

## 4.3 The Three PEOs of Dr. D. Y. Patil Pratisthan's College of Engineering

### PEO1: Technical Contribution to Organizational Growth

- To work and contribute their mite to the growth of the organization utilizing their technical abilities.
- Graduates apply their engineering knowledge and technical skills to create value in organizations within 3-5 years of graduation.

### PEO2: Lifelong Learning and Industry Advancement

- Continue to upgrade their capabilities through lifelong learning and contribute to the growth of IT sector.
- Graduates recognize that engineering knowledge evolves continuously and commit to professional development, staying current with emerging technologies and contributing to industry advancement.

### PEO3: Professional Service and Sustainable Development

To render best possible service as an employee, entrepreneur for the overall sustainable development of society.

Graduates practice their profession with integrity and commitment to societal and environmental benefit, whether as employees or entrepreneurs.

## 4.4 Alignment with Institutional Mission

| PEO | Mission Aligned |
|---|---|
| PEO1 | M1, M2 |
| PEO2 | M1, M2, M4 |
| PEO3 | M1, M3, M4 |

## 4.5 Assessment of PEOs

PEOs are assessed through: - Alumni surveys (graduates 1-5 years post-graduation) - Employer feedback on graduate career performance - Career progression tracking - Professional certifications and continued learning - Evidence of ethical and sustainable practices.

# CHAPTER 5: PROGRAMME OUTCOMES (POs)

## 5.1 Definition

Programme Outcomes (POs) explain the knowledge, skills, and attitudes that students are expected to attain upon graduation. POs represent the core professional competencies all engineering graduates must demonstrate.

## 5.2 Knowledge and Attitude Profile (WK)

The Knowledge and Attitude Profile describes the essential knowledge domains and professional attitudes that support the achievement of Program Outcomes. There are nine WK domains:

**WK1:** Systematic, theory-based understanding of natural sciences applicable to the discipline and awareness of relevant social sciences.

**WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics, and formal aspects of computer and information science.

**WK3:** Systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

**WK4:** Engineering specialist knowledge providing theoretical frameworks and advanced knowledge in the specialization.

**WK5:** Knowledge of efficient resource use, environmental impacts, whole-life cost, net zero carbon concepts supporting engineering design and operations.

**WK6:** Knowledge of engineering practice (technology) in practice areas within the engineering discipline.

**WK7:** Knowledge of the role of engineering in society, professional responsibility to public safety, and sustainable development.

**WK8:** Engagement with current research literature and awareness of critical thinking and creative approaches to emerging issues.

**WK9:** Ethics, inclusive behavior, professional ethics, responsibilities, norms of engineering practice, and awareness of diversity.

## 5.3 The Eleven Programme Outcomes

### PO1 - Engineering Knowledge (WK1, WK2, WK3, WK4)

Apply knowledge of mathematics, natural sciences, computing, engineering fundamentals, and an engineering specialization to develop solutions to complex engineering problems.

## PO2 - Problem Analysis (WK1, WK2, WK3, WK4, WK8)

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 (WK1, WK2, WK3, WK4, WK5, WK8)

Design creative solutions for complex engineering problems and design systems, components, or processes that meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment.

## PO4 - Conduct Investigations of Complex Problems (WK1, WK2, WK3, WK4, WK8)

Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis, and interpretation of data to provide valid conclusions.

## PO5 - Engineering Tool Usage (WK4, WK6)

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems.

## PO6 - The Engineer and The World (WK5, WK6, WK7, WK9)

Analyze and evaluate societal, health, safety, legal, and cultural issues and the consequential responsibilities relevant to the professional engineering practice.

## PO7 - Ethics (WK9)

Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national and international legal regulations.

## PO8 - Individual and Collaborative Team Work (WK9)

Function effectively as an individual, and as a member or leader in diverse, multidisciplinary teams and in multidisciplinary settings.

## PO9 - Communication (WK9)

Communicate effectively and inclusively with the engineering community and society at large by comprehending and writing effective reports and design documentation, making effective presentations, and giving and receiving clear instructions.

## PO10 - Project Management and Finance (WK6, WK7)

Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects in multidisciplinary environments.

### PO11 - Life-Long Learning (WK8)

Recognize the need for, and have the preparation and ability for engagement in independent and life-long learning in the broadest context of technological change.

## 5.4 PO-WK Mapping Summary

| Programme Outcome | Mapped WK Profiles |
|---|---|
| PO1 - Engineering Knowledge | WK1, WK2, WK3, WK4 |
| PO2 - Problem Analysis | WK1, WK2, WK3, WK4, WK8 |
| PO3 - Design/Development | WK1, WK2, WK3, WK4, WK5, WK8 |
| PO4 - Investigations | WK1, WK2, WK3, WK4, WK8 |
| PO5 - Tool Usage | WK4, WK6 |
| PO6 - Engineer and World | WK5, WK6, WK7, WK9 |
| PO7 - Ethics | WK9 |
| PO8 - Team Work | WK9 |
| PO9 - Communication | WK9 |
| PO10 - Project Management | WK6, WK7 |
| PO11 - Lifelong Learning | WK8 |

## 5.5 Assessment of Programme Outcomes

POs are assessed through:

**Direct Assessment (80% weightage):** - Course outcomes mapped to each PO - Aggregation of CO attainment across courses - Comprehensive examination analysis - Practical and project evaluations

**Indirect Assessment (20% weightage):** - Course exit surveys - Program exit surveys - Alumni feedback - Employer surveys

**Threshold:** At Dr. D. Y. Patil Pratisthan's College of Engineering, PO attainment below **1.50** triggers improvement actions.

# CHAPTER 6: PROGRAM SPECIFIC OUTCOMES (PSOs)

## 6.1 Definition

Program Specific Outcomes (PSOs) are discipline-specific competencies that extend and specialize the generic Program Outcomes within the context of a particular engineering discipline or program.

## 6.2 Characteristics of PSOs

- Discipline-specific and unique to each engineering program.
- Complement and extend the generic 11 Program Outcomes.
- Reflect contemporary industry practices and emerging technologies.
- Typically 2-3 per program.
- Aligned with employer and industry expert expectations.
- Support specialized knowledge development within the discipline.

## 6.3 Program Specific Outcomes by Department

### Computer Science and Engineering (CSE)

**PSO1:** Demonstrate the knowledge of recent technologies like Web Development, Mobile Computing, Cloud Computing, Big Data Analytics, Deep Learning, etc.

**PSO2:** Demonstrate the knowledge of Programming languages in computer-based problem solving.

**PSO3:** Demonstrate the ability to analyze, design, and implement software solutions effectively.

### Computer Science and Engineering (Data Science)

**PSO1 - Professional Skills:** Apply the concepts and practical knowledge in analysis, design and development of data systems and applications to multidisciplinary problems.

**PSO2 - Competency:** Provide a concrete foundation and enrich their abilities to qualify for Employment, Higher studies and Research in Data science with ethical values.

### Civil Engineering

**PSO1:** To enhance employability and entrepreneurship skills through global engineering practices, soft skills and onsite training.

**PSO2:** To develop technical skills and innovative research practices to provide solutions/procedures to societal and rural development problems.

### Electrical Engineering

**PSO1:** Technical excellence in electrical engineering design and operations.

**PSO2:** Application of advanced electrical engineering concepts to contemporary industry and societal challenges.

## 6.4 Relationship between POs and PSOs

PSOs do **not replace** Program Outcomes; they **complement and extend** them:

- All graduates must achieve the 11 generic POs
- Additional PSOs ensure discipline-specific expertise
- PSOs are mapped to relevant POs, showing how specialized competencies build upon generic outcomes

## 6.5 Assessment of PSOs

PSOs are assessed through:

- Course outcomes specifically designed to develop PSO competencies
- Specialized projects and capstone assignments
- Industry-specific assessments and practicals
- Employer feedback on discipline-specific skills
- Alumni surveys on specialized competency application

# CHAPTER 7: COURSE OUTCOMES (COs)

## 7.1 Definition

Course Outcomes outline the course specifications to be acquired by students and describe what students will know, understand, and be able to perform as a result of their learning experiences in a course.

## 7.2 Dr. D. Y. Patil Pratisthan's College of Engineering - CO Development Guidelines

### A. General Guidelines for Writing Course Outcomes

**Use Action Verbs:** Use explicit and quantifiable action verbs including analyze, evaluate, demonstrate, apply, create, and compare when crafting Course Outcomes to accurately articulate anticipated student learning and accomplishments. Assign a numerical prefix starting from 1 to each CO for clarity (CO1, CO2, CO3, etc.).

**Cover Different Cognitive Levels:** Ensure COs span various cognitive levels, drawing from Bloom's Taxonomy, to engage students in diverse thinking processes like remembering, understanding, applying, analyzing, evaluating, and creating.

**Be Achievable:** Craft COs that are realistic and attainable within the course's timeframe, considering the course level, student backgrounds, abilities, and available resources.

**Be Measurable:** Design COs that are observable and measurable, facilitating progress assessment through appropriate evaluations. Avoid the use of two action verbs such as "Differentiate and Analyze." Reframe as separate outcomes as needed.

**Count:** Aim for a preferable range of **4-6 Course Outcomes per 4-credit course**. Adjust proportionally for courses with different credit hours.

## 7.3 Bloom's Taxonomy and Action Verbs

Bloom's Taxonomy classifies learning into six cognitive levels. Each level requires appropriate action verbs:

| Level | Description | Example Action Verbs |
|---|---|---|
| **1. Remember** | Recall facts and definitions | Define, List, State, Name, Identify, Recall, Recognize |
| **2. Understand** | Explain ideas and concepts | Explain, Describe, Summarize, Interpret, Classify, Discuss |
| **3. Apply** | Use information in new situations | Apply, Use, Demonstrate, Solve, Implement, Calculate, Show |
| **4. Analyze** | Draw connections among ideas | Analyze, Compare, Differentiate, Distinguish, Examine, Categorize |

| Level | Description | Example Action Verbs |
|---|---|---|
| **5. Evaluate** | Justify decisions and choices | Evaluate, Critique, Judge, Justify, Assess, Appraise, Recommend |
| **6. Create** | Produce new or original work | Design, Develop, Construct, Create, Formulate, Propose, Synthesize |

## 7.4 Characteristics of Well-Written Course Outcomes

- Specific and clearly stated
- Measurable and observable
- Aligned with one or more Program Outcomes (POs)
- Appropriate to the course level and credit hours
- Use single action verb (not multiple verbs)
- Focused on one learning capability per outcome
- Written from student perspective
- Achievable within course timeframe

## 7.5 SMART Criteria for Course Outcomes

Course Outcomes should be SMART:

- **Specific:** Clear and well-defined; not vague or ambiguous
- **Measurable:** Can be assessed and verified through specific assessment methods
- **Achievable:** Realistic and attainable given course duration and student level
- **Relevant:** Directly aligned with course content and program goals
- **Time-bound:** Must be achieved by end of course

## 7.6 Common Mistakes in CO Writing

| Mistake | Example | Correction |
|---|---|---|
| **Vague verbs** | "Know database concepts" | "Explain database normalization concepts" |
| **Multiple action verbs** | "Analyze and design database systems" | Split into: CO1: Analyze database requirements; CO2: Design database schema |
| **Instructor focused** | "Teach OOP principles" | "Apply OOP principles to solve design problems" |
| **Too broad** | "Understand engineering" | "Apply engineering principles to bridge design" |
| **Not measurable** | "Appreciate software design" | "Evaluate software design quality using design patterns" |
| **Unclear degree** | "Create a program" | "Create a working program that meets all specifications and passes unit tests" |

## 7.7 Number of Course Outcomes

**Standard Range:** 4-6 Course Outcomes per 4-credit course

**Adjustment for Different Credit Hours:** - 1-credit course: 2-3 COs - 2-credit course: 3-4 COs - 3-credit course: 4-5 COs - 4-credit course: 4-6 COs - 5-credit course: 5-6 COs

## 7.8 Cognitive Level Distribution

For a 4-6 CO course, recommended distribution:

- **Level 1-2 (Remember/Understand):** 1-2 outcomes (foundational knowledge)
- **Level 3-4 (Apply/Analyze):** 2-3 outcomes (practical application)
- **Level 5-6 (Evaluate/Create):** 1-2 outcomes (higher-order thinking)

This ensures balanced cognitive development across the course.

## 7.9 Relationship: Course Outcomes to Program Outcomes

- Each CO is mapped to one or more POs
- COs form the foundation for PO achievement
- Aggregation of CO attainment contributes to PO attainment
- All Program Outcomes should be addressed across the program through various courses
- A single CO may contribute to multiple POs

## 7.10 Course Outcome Development Process

**Step 1:** Identify course purpose and position in curriculum

**Step 2:** List knowledge, skills, and attitudes students should develop

**Step 3:** Write outcomes using action verbs, ensuring single verb per outcome

**Step 4:** Verify coverage of multiple Bloom's levels

**Step 5:** Ensure 4-6 outcomes appropriate to course credit hours

**Step 6:** Map each CO to relevant POs

**Step 7:** Validate with faculty and PAQIC

**Step 8:** Finalize and document in course syllabus with numerical prefix (CO1, CO2, etc.)

**Step 9:** Communicate to students on first day of class

**Step 10:** Design assessments aligned to each CO

## 7.11 Assessment Alignment

Each Course Outcome must have:

- **Clear assessment method:** Test question, project task, practical exercise, or assignment
- **Aligned rubric:** Scoring criteria directly mapped to the outcome
- **Measurable criteria:** Specific performance indicators
- **Documentation:** Record of attainment for each CO

## 7.12 Documentation in Course Syllabus

Course syllabus must include:

- **Course Code and Title**
- **Credit Hours**
- **Course Outcomes:** Listed as CO1, CO2, CO3, etc. with action verbs
- **Mapping:** CO to PO/PSO mapping table
- **Assessment Methods:** How each CO will be assessed
- **Rubrics:** Scoring guides for each CO assessment

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# CHAPTER 8: PEDAGOGY FOR THEORY AND PRACTICAL COURSES

## 8.1 Definition

Pedagogy refers to the art and science of teaching - the methods, strategies, and approaches used to facilitate student learning and the development of Course Outcomes.

## 8.2 Importance of Pedagogical Diversity

Different Course Outcomes require different teaching approaches. A single lecture-based method cannot effectively develop all cognitive levels and competencies. Therefore, engineering programs must employ diverse pedagogical approaches aligned to specific outcomes.

## 8.3 Pedagogical Approaches for Theory Courses

### 8.3.1 Lecture with Active Learning Integration

**Purpose:** Develop foundational knowledge (Bloom's Levels 1-2) while maintaining engagement.

**Method:** - Faculty presents core concepts and theories - Students engage through questioning, discussions, and reflection - Breaks in lecture for pair-share or group activities - Real-world examples connecting theory to practice

**When to Use:** Foundational concepts requiring comprehensive overview; large class sizes; content-heavy topics.

**Outcome Levels:** Remember, Understand

### 8.3.2 Problem-Based Learning (PBL)

**Purpose:** Develop problem-solving and analytical skills (Bloom's Levels 3-4).

**Method:** - Students encounter realistic engineering problems - Faculty guides inquiry rather than providing direct answers - Students research, analyze, and propose solutions - Emphasis on process over single correct answer

**When to Use:** Complex, open-ended problems; promoting independent learning; integration of concepts.

**Outcome Levels:** Apply, Analyze

### 8.3.3 Case Study Method

**Purpose:** Develop decision-making and critical analysis (Bloom's Levels 4-5).

**Method:** - Students analyze real or realistic scenarios from industry/practice - Examine multiple perspectives and constraints - Evaluate alternative solutions - Justify recommendations with evidence

**When to Use:** Professional practice contexts; ethical dilemmas; management decisions; when learning from others' experiences.

**Outcome Levels:** Analyze, Evaluate

### 8.3.4 Cooperative/Collaborative Learning

**Purpose:** Develop teamwork, communication, and shared problem-solving (PO8, PO9).

**Method:** - Students work in structured groups with defined roles - Individual accountability combined with group interdependence - Peer teaching and learning from classmates - Structured reflection on group process

**When to Use:** Developing teamwork skills; complex projects requiring multiple perspectives; leadership development.

**Outcome Levels:** All levels; enhanced through peer interaction

### 8.3.5 Flipped Classroom

**Purpose:** Maximize class time for application and reduce passive lecture time (Bloom's Levels 3-6).

**Method:** - Students access foundational content outside class (videos, readings, online modules) - Class time devoted to problem-solving, discussions, projects - Faculty acts as facilitator and guide rather than primary information source

**When to Use:** When foundational content can be accessed independently; to maximize active engagement; to personalize learning pace.

**Outcome Levels:** Apply, Analyze, Evaluate, Create

### 8.3.6 Inquiry-Based Learning

**Purpose:** Develop research skills and independent learning (Bloom's Levels 3-6, PO11).

**Method:** - Students formulate research questions and design investigations - Faculty provides structure and guidance on methodology - Students conduct research, interpret results, draw conclusions - Emphasis on scientific thinking and adaptation

**When to Use:** Research-oriented courses; innovation and design; developing lifelong

learning skills.

**Outcome Levels:** Apply, Analyze, Evaluate, Create

## 8.4 Pedagogical Approaches for Practical/Laboratory Courses

### 8.4.1 Structured Laboratory Experiments

**Purpose:** Develop practical skills and verify theoretical concepts (Bloom's Levels 1-3).

**Method:** - Faculty provides detailed procedures and protocols - Students follow steps to conduct experiments - Expected results known in advance - Emphasis on technique and proper execution

**When to Use:** Teaching laboratory safety and techniques; demonstrating theory; building confidence with equipment.

**Outcome Levels:** Remember, Understand, Apply

### 8.4.2 Open-Ended Laboratory Projects

**Purpose:** Develop design, problem-solving, and creative thinking (Bloom's Levels 3-6).

**Method:** - Students define the problem within given constraints - Design experiment/procedure to investigate question - Unexpected results encouraged and analyzed - Emphasis on inquiry and discovery

**When to Use:** Higher-level courses; developing innovation; preparing for capstone and research.

**Outcome Levels:** Apply, Analyze, Evaluate, Create

### 8.4.3 Simulation and Virtual Labs

**Purpose:** Provide safe, repeatable practice for dangerous or expensive scenarios.

**Method:** - Software or online platforms simulate real equipment and processes - Students practice procedures without physical risk or cost - Immediate feedback on outcomes - Multiple trials enabling mastery

**When to Use:** Safety-critical operations; expensive equipment; scenarios difficult to recreate; additional practice opportunities.

**Outcome Levels:** Apply, Analyze

### 8.4.4 Hands-On Design Projects

**Purpose:** Develop design thinking and creative problem-solving (Bloom's Levels 5-6).

**Method:** - Students design and build solutions to real problems - Iteration based on testing and feedback - Integration of theory and practice - Documentation and presentation of design process

**When to Use:** Capstone courses; senior projects; integrative experiences; real-world problem solving.

**Outcome Levels:** Evaluate, Create

### 8.4.5 Competency-Based Practical Assessment

**Purpose:** Ensure students demonstrate required practical competencies (PO5 - Tool Usage).

**Method:** - Clear rubrics defining competency levels - Hands-on demonstration of skills - Faculty observation and assessment - Individual assessment of each student

**When to Use:** Safety-critical skills; equipment operation; professional licensing requirements.

**Outcome Levels:** Apply, Analyze

## 8.5 Integration of Real-World Applications

All pedagogical approaches should include:

- **Industry examples:** Current practices and solutions
- **Professional context:** How learning applies to careers
- **Authentic problems:** Scenarios engineers actually face
- **Guest lectures:** Industry professionals sharing experiences
- **Site visits:** Observing real applications
- **Industry projects:** Working on problems from partner organizations

## 8.6 Scaffolding and Support Mechanisms

**Scaffolding** helps students progress from dependent to independent learning:

- **Model procedures:** Faculty demonstrates before students attempt
- **Guided practice:** Faculty supports student attempts with feedback
- **Independent practice:** Students apply with minimal guidance
- **Reflection:** Students think about and articulate their learning

**Support mechanisms:** - Office hours for individual clarification - Tutoring for struggling students - Peer mentoring programs - Study groups and collaborative learning spaces

## 8.7 Differentiation for Diverse Learners

Engineering students have varied learning styles and backgrounds:

- **Visual learners:** Diagrams, flowcharts, simulations
- **Auditory learners:** Discussions, presentations, explanations
- **Kinesthetic learners:** Hands-on projects, labs, demonstrations
- **Analytical learners:** Problem-solving, data analysis
- **Holistic learners:** Real-world applications, integration

Effective faculty employ multiple approaches within single course.

## 8.8 Use of Technology in Teaching

**Learning Management System (LMS):** - Course materials and announcements - Assignment submission and grading - Discussion forums and Q&A - Grade tracking aligned to outcomes

**Digital Content Delivery:** - Video lectures and tutorials - Interactive simulations and animations - Online quizzes and assessments - Digital references and resources

**NPTEL and Online Resources:** - Supplementary videos on specific topics - Alternative explanations for diverse learners - Access to experts and best practices - Cost-effective learning materials

**Simulation Software:** - Virtual labs and experiments - 3D modeling and visualization - Data analysis tools - Professional engineering software

# CHAPTER 9: CLASS CONDUCTING METHODS

## 9.1 Definition

Class conducting methods refer to the systematic processes and strategies faculty use to organize, deliver, and manage classroom activities to facilitate student learning aligned to Course Outcomes.

## 9.2 Pre-Class Preparation

### 9.2.1 Course Planning and Preparation

**Annual Planning:** - Align course to program outcomes and curriculum structure - Identify prerequisite knowledge and skills students should possess - Plan sequence of topics supporting progression through cognitive levels - Determine mix of teaching methodologies aligned to outcomes

**Semester Planning:** - Create detailed course calendar with topics, assessments, and deadlines - Identify connections between topics and real-world applications - Plan integration with other courses in the semester - Allocate time for each unit considering course load

### 9.2.2 Creation of Course Calendar

**Essential Elements:** - Course dates and schedule (including breaks and holidays) - Topic covered in each class - Major assessments and deadlines - Milestones for projects and assignments - Course outcome coverage by unit

**Communication:** - Distribute calendar to students on first day of class - Post on LMS for easy reference - Update if changes occur (communicate promptly)

### 9.2.3 Design of Lesson Plans Aligned to COs

**For Each Class/Unit:** - Specific course outcome(s) being addressed - Learning objectives for the session - Teaching methodology selected - Student activities and engagement strategies - Assessment methods for that session - Time allocation - Required materials and resources

### 9.2.4 Resource Preparation

**Materials and Equipment:** - Lecture slides, handouts, case studies - Laboratory equipment and materials checked - Simulation software and technology tested - Additional resources (articles, videos, guest contacts)

**Student Resources:** - Course materials uploaded to LMS - Assignment guidelines and rubrics prepared - Assessment tools developed and validated - Support resources identified.

## 9.3 During-Class Strategies

### 9.3.1 Opening: Connecting to Prior Learning

**First 5-10 minutes:** - Communicate course outcome for the session - Connect to previous class (review key concepts) - Outline today's agenda and activities - Establish relevance to professional practice - Address student questions from prior learning

### 9.3.2 Main Instruction: Diverse Methodologies

**Content Delivery:** - Use appropriate pedagogical method(s) based on outcomes - Present information in multiple formats (visual, auditory, textual) - Use real-world examples connecting theory to practice - Break content into manageable chunks - Check understanding before proceeding

**Pacing:** - Not too fast (students cannot follow) - Not too slow (students disengage) - Allow processing time after explaining concepts - Adjust based on student response

### 9.3.3 Active Engagement Techniques

**Think-Pair-Share:** - Pose question to class - Students think individually (1 minute) - Discuss with partner (2 minutes) - Share key ideas with class (facilitated discussion)

**Minute Papers:** - Last few minutes of class, students write response to: "What's one thing you learned?" and "What's still unclear?" - Collect for faculty review before next class - Inform faculty on what to clarify

**Classroom Polling:** - Use clickers or hand-raise to gather real-time student understanding - Reveal results and discuss misconceptions - No grading; supports formative assessment

**Group Discussions:** - Small groups discuss assigned question or scenario - Groups report findings - Peer learning and multiple perspectives

**Peer Teaching:** - Advanced students explain concepts to classmates - Develops deeper understanding for teacher - Provides alternative explanation for listener

### 9.3.4 Real-World Examples and Applications

**Industry Context:** - Case studies from engineering practice - Guest lectures from professionals - Site visits observing applications - Projects from industry partners - Current news and innovations in field

**Relevance to Outcomes:** - Connect examples to specific course outcomes - Show how outcomes are used in professional practice - Motivate students by demonstrating purpose

### 9.3.5 Q&A and Clarification Sessions

**Creating Safe Environment:** - Encourage questions without judgment - Value wrong answers as learning opportunities - Respond respectfully and thoroughly - Admit when you don't know (model lifelong learning)

**Tracking Questions:** - Note common misconceptions - Address recurring issues in next class - Adjust teaching based on questions

### 9.3.6 Closing: Summary and Connection to Next Lesson

**Last 5-10 minutes:** - Summarize key concepts covered - Review relationship to course outcomes - Preview next class and its relevance - Connect to long-term program goals - Collect minute papers or quick assessment

## 9.4 Student Engagement Techniques

**In-Class Activities:** - Problem-solving exercises (individual/group) - Laboratory demonstrations and hands-on work - Simulations and virtual experiments - Project work and presentations - Debates and discussions - Role-plays for professional scenarios

**Motivation Strategies:** - Start with interesting hook/challenge - Explain relevance to career and society - Celebrate achievements and progress - Provide constructive feedback regularly - Create inclusive and supportive environment

## 9.5 Classroom Management and Inclusive Practices

**Classroom Environment:** - Arrange seating to facilitate engagement - Establish clear expectations and norms - Address disruptive behavior promptly and professionally - Create psychological safety for all students - Respect diverse backgrounds and perspectives

**Inclusive Practices:** - Use gender-neutral language - Include examples representing diverse populations - Accommodate students with disabilities - Provide alternative formats for materials - Ensure all students have voice in discussions

## 9.6 Attendance Tracking and Documentation

**Attendance Policy:** - Take attendance regularly - Communicate policy to students - Track attendance patterns - Identify at-risk students (frequent absences) - Follow institutional policies on attendance

**Documentation:** - Maintain records in LMS - Share with department/PAQIC if needed - Use data for student interventions

## 9.7 Unit Tests and Formative Assessments

### 9.7.1 Frequency and Schedule

- **Mini-quizzes:** Every 1-2 weeks (low stakes, no/minimal grade impact)
- **Unit tests:** At end of major unit (higher stakes)
- **Cumulative assessments:** Periodically integrate prior learning
- **Scheduled in syllabus:** Students know when to expect

### 9.7.2 Question Bank Aligned to COs

**Design:** - Questions targeting each course outcome - Multiple question types (MCQ, short answer, problem-solving) - Range of difficulty levels (Bloom's Levels 1-6) - Clear rubrics for subjective questions

**Maintenance:** - Continuously build and refine question bank - Track performance on each question - Remove ambiguous questions - Add new questions reflecting current

practice

### 9.7.3 Quick Feedback Loops

**During Class:** - Clicker questions with immediate discussion of results - Think-pair-share revealing misconceptions - Hand-raise responses revealing understanding

**Assessment Turnaround:** - Quick quizzes graded within 1-2 days - Feedback provided promptly - Students see scoring rubric - Opportunities to correct misunderstandings before moving on

## 9.8 Post-Class Activities

### 9.8.1 Assignment Distribution and Grading

**Assignment Design:** - Clearly aligned to course outcomes - Rubric provided to students with assignment - Due dates reasonable (adequate time for learning) - Variety of assignment types (essays, problems, projects, presentations)

**Grading Process:** - Use standardized rubric consistently - Provide written feedback beyond numeric score - Note common errors for class discussion - Return within reasonable timeframe (typically 1 week)

### 9.8.2 Feedback to Students

**Effective Feedback:** - Specific: Point to exactly what needs improvement - Actionable: Student can understand what to do differently - Timely: Provided soon after assessment - Encouraging: Acknowledges strengths while addressing gaps - Aligned to outcomes: Connects to learning goals

**Feedback Methods:** - Written comments on assignments - Individual conferences during office hours - Class-level feedback addressing common issues - Peer feedback on group projects - Self-reflection prompts

### 9.8.3 Identification of Struggling Students

**Early Identification:** - Performance on formative assessments - Attendance patterns - Participation trends - Assignment completion rates - Student self-reports

**Intervention:** - Individual meetings to understand challenges - Tutoring referrals - Study strategy coaching - Resource connections (counseling, disability services) - Adjusted support or accommodations as needed

### 9.8.4 Remedial Support Planning

**Support Services:** - Faculty office hours - Tutoring (peer or professional) - Supplemental instruction sessions - Review/practice materials - Alternative explanations or resources

**Documentation:** - Record interventions attempted - Track student progress - Adjust support based on effectiveness - Communicate with department about persistent struggles.

# CHAPTER 10: ASSESSMENT METHODS

## 10.1 Definition

Assessment Methods are techniques and instruments used to measure and evaluate the extent to which students have achieved Course Outcomes and Program Outcomes.

## 10.2 Assessment Framework at Dr. D. Y. Patil Pratisthan's College

**Weightage Distribution:** - Direct Assessment: 80% - Indirect Assessment: 20%

## 10.3 Direct Assessment Methods (80% Weightage)

Direct assessment measures actual student performance and demonstration of competencies.

### 10.3.1 Continuous Internal Evaluation (CIE)

**Purpose:** Measure achievement of COs throughout the semester.

**Components:** - **Mid-semester tests:** One comprehensive test covering first half of content - **Unit tests/Quizzes:** Short assessments after each unit (typically 30-45 minutes) - **Assignments:** Problem-solving, analysis, or application tasks - **Participation:** In-class engagement, discussions, group work

**Frequency:** Multiple assessments distributed throughout semester (not concentrated at end)

**Alignment:** Each assessment targets specific course outcomes.

### 10.3.2 University Semester End Examination (SEE)

**Purpose:** Comprehensive assessment of all COs at semester end.

**Format:** - Written examination (3 hours typical duration) - Multiple question types (MCQ, short answer, problem-solving, essay) - Designed to assess all Bloom's cognitive levels - Cumulative (can include prior learning)

**Scope:** Covers all course outcomes across the full course content

**Grading:** Standardized marking scheme; consistent evaluation criteria

### 10.3.3 Practical/Laboratory Work

**Purpose:** Assess hands-on skills and application of concepts (PO5).

**Components:** - **Structured experiments:** Conducting prescribed procedures correctly - **Open-ended projects:** Designing and executing investigations - **Technical skills:** Equipment operation, measurement accuracy - **Lab reports:** Documentation and analysis of findings - **Viva/Oral:** Questioning to assess understanding

**Assessment:** Based on rubric evaluating procedure, accuracy, safety, analysis, and

communication.

### 10.3.4 Assignments and Projects

**Purpose:** Assess application, analysis, and creation (Bloom's Levels 3-6).

**Types:** - **Problem sets:** Application of concepts to new situations - **Design projects:** Creating solutions to engineering challenges - **Research reports:** Literature review and analysis - **Case study analysis:** Evaluating professional scenarios - **Mini-projects:** Smaller scope integrative assessments

**Rubric:** Clear criteria for each quality level; aligned to outcomes.

### 10.3.5 Presentations

**Purpose:** Assess communication skills and depth of understanding (PO9).

**Format:** - Individual presentations on assigned topics - Group presentations on projects - Poster presentations - Defense of capstone/final project

**Evaluation:** Assessed on technical content, clarity, visual aids, response to questions, and professionalism.

## 10.4 Indirect Assessment Methods (20% Weightage)

Indirect assessment captures stakeholder perceptions and feedback.

### 10.4.1 Course Exit Survey (CESA)

**Purpose:** Collect student feedback on course effectiveness and their learning.

**Administration:** Last class of semester (paper or online).

**Questions Address:** - Course outcome achievement ("I learned the concepts in this course") - Teaching effectiveness ("Teaching methods were appropriate") - Relevance ("Content was relevant to my career") - Support ("I received adequate feedback and support") - Workload ("Course load was manageable")

**Analysis:** Calculate % of students agreeing/disagreeing; identify improvement areas.

**Outcome Mapping:** Questions directly reference specific course outcomes.

### 10.4.2 Program Exit Survey

**Purpose:** Graduating students assess overall program quality and PO achievement.

**Administration:** Final semester before graduation; all graduating students.

**Questions Address:** - Program Outcomes achievement ("I can apply engineering knowledge") - Overall program quality - Preparation for professional practice - Curriculum relevance - Faculty support and resources - Career readiness

**Analysis:** Aggregate across all seniors; identify program-level strengths and gaps.

### 10.4.3 Alumni Survey

**Purpose:** Assess PEO achievement through career success; gather long-term feedback.

**Timeline:** Administer 1-5 years post-graduation.

**Questions Address:** - Career progression ("I have advanced in my career") - Competency application ("I regularly use engineering knowledge learned") - Professional responsibility ("I practice engineering ethically") - Lifelong learning ("I engage in professional development") - Curriculum relevance ("Education prepared me for current role")

**Analysis:** Provides evidence of PEO achievement; identifies curriculum gaps relative to professional needs.

### 10.4.4 Employer Survey

**Purpose:** Assess graduate competencies from employer perspective; identify skill gaps.

**Target:** Employers hiring graduates; conduct periodically.

**Questions Address:** - Graduate competencies ("Graduates possess required technical skills") - Communication ("Graduates communicate effectively") - Teamwork ("Graduates work well in teams") - Problem-solving ("Graduates approach problems systematically") - Professional responsibility ("Graduates practice ethics and professionalism") - Emerging skill needs ("Current graduates lack skills in…")

**Analysis:** Identify misalignment between education and industry needs; guide curriculum updates.

### 10.4.5 Industry Expert Consultation

**Purpose:** Gather input on contemporary practices and emerging needs.

**Format:** - Surveys or interviews with industry professionals - Advisory board meetings - Focus groups on specific topics

**Input On:** - Current best practices in discipline - Emerging technologies and skills - Evolution of professional roles - Recommendations for curriculum

## 10.5 Assessment Tool Selection and Design

**Alignment to Outcomes:** - Each tool must measure specific, identified outcomes - Match assessment method to cognitive level being assessed (Bloom's) - Multiple methods used to assess each outcome (triangulation)

**Validity and Reliability:** - **Validity:** Does tool actually measure the outcome? (content validity) - **Reliability:** Would different raters reach same conclusion? (use rubrics for consistency) - Review questions for ambiguity before administering - Pilot assess on sample before full implementation

**Rubric Development:** - Clear performance levels (typically 4-5 levels) - Descriptive criteria for each level - Specific examples helping raters understand levels - Focus on outcome achievement, not overall quality

## 10.6 Consistency and Calibration

**Rubric Calibration Sessions:** - Faculty review rubric together - Grade sample work independently - Compare judgments and discuss differences - Refine rubric language for clarity - Reach consensus on standards

**Faculty Moderation:** - Review sample of student work from multiple raters - Ensure consistent application of rubric - Discuss edge cases and gray areas - Provide feedback to faculty - Reduce bias in grading

**Consistency Across Sections:** - Coordinate assessment schedule across multiple course sections - Use identical or very similar assessment tools - Compare results across sections - Address significant discrepancies

## 10.7 Technology-Enabled Assessment

**Online Platforms:** - Learning Management System (LMS) quiz tools - Automated scoring for objective questions - Assignment submission and grading tracking

**Learning Analytics:** - Dashboard showing attainment by outcome - Identifying students at risk - Tracking trends over time - Predicting future performance

**Assessment Data Management:** - Central repository for all assessment data - Automated calculation of attainment percentages - Report generation for program review - Historical data for trend analysis.

# CHAPTER 11: COs AND POs MAPPING

## 11.1 Definition

CO-PO Mapping (also called Articulation Matrix) is a systematic process of linking Course Outcomes to Program Outcomes and Program Specific Outcomes, showing how each course contributes to achieving broader program goals.

## 11.2 Purpose of Articulation Matrices

**Visibility:** Shows explicitly which courses address which Program Outcomes.

**Alignment Verification:** Ensures all POs are adequately addressed across the curriculum.

**Gap Identification:** Reveals outcomes with insufficient course coverage.

**Program Analysis:** Enables assessment of curriculum balance and progression.

**Accreditation:** Required documentation for NBA, NAAC, ABET.

## 11.3 Understanding Correlation Levels

The strength of relationship between CO and PO is indicated by correlation ratings:

**3 = High Correlation:** The course outcome directly and substantially contributes to achievement of the program outcome. The CO directly assesses competency required for the PO.

**2 = Medium Correlation:** The course outcome moderately contributes to achievement of the program outcome. The CO supports development but may not fully assess the competency.

**1 = Low Correlation:** The course outcome minimally contributes to achievement of the program outcome. The CO has peripheral relevance to the PO.

**– = No Correlation:** The course outcome does not address the program outcome.

## 11.4 CO-PO Articulation Matrix Development

**Step 1:** List all Course Outcomes for the course (rows)

**Step 2:** List all Program Outcomes (columns)

**Step 3:** For each CO-PO pair, determine if and how strongly the CO contributes to the PO

**Step 4:** Assign correlation level (3, 2, 1, or –)

**Step 5:** Provide justification for each mapping, especially for ratings of 2 and 3

**Step 6:** Validate with faculty and PAQIC

**Step 7:** Document in Faculty Record Book

## 11.5 CO-PSO Articulation Matrix Development

**Similar Process:** Same methodology as CO-PO mapping.

**Purpose:** Shows how course outcomes contribute to discipline-specific competencies.

**Frequency:** PSO mappings may be more selective (not every course addresses every PSO).

## 11.6 Sample CO-PO Articulation Matrix

| Course Outcome | PO1 | PO 2 | PO3 | PO4 | PO 5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1: Explain data science fundamentals | 3 | 2 | – | 1 | – | – | – | – | – | – | 2 |
| CO2: Describe data science process | 3 | 3 | 1 | 2 | – | – | – | – | – | 1 | – |
| CO3: Apply Python libraries | 2 | 3 | 2 | 3 | 3 | – | – | – | – | – | – |
| CO4: Design data solutions | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | – |
| CO5: Communicate findings | – | 1 | – | – | – | 2 | – | 2 | 3 | – | – |

## 11.7 Justification for Each Mapping

**Strong Justifications (Rating 3):** "CO3 (Apply Python libraries) receives rating 3 for PO5 (Engineering Tool Usage) because the CO directly teaches selection and application of Python as an engineering tool, with practice on real datasets and assessment of tool proficiency."

**Medium Justifications (Rating 2):** "CO1 (Explain data science fundamentals) receives rating 2 for PO2 (Problem Analysis) because understanding fundamentals supports problem analysis, but dedicated problem-solving is addressed more thoroughly in CO4."

**Weak Justifications (Rating 1):** "CO1 receives rating 1 for PO4 because foundational knowledge provides context but the course doesn't emphasize design of investigations."

## 11.8 Review and Validation of Matrices

**Peer Review:** Faculty review each other's mappings for reasonableness.

**PAQIC Validation:** Committee ensures matrices are credible and complete.

**Annual Updates:** Revise if course content changes or outcomes modified.

**Refinement:** Adjust based on attainment data (if course outcomes not assessing intended outcomes effectively).

## 11.9 Using Matrices for Curriculum Analysis

**Outcome Coverage:** - Count number of courses addressing each PO - Identify POs with single course coverage (fragile; needs backup) - Identify highly-covered outcomes (perhaps redundant)

**Balance Assessment:** - Verify all POs addressed - Check for equal emphasis across outcomes - Assess progression (introductory to advanced)

**Gap Identification:** - POs with no 3-ratings (insufficient depth) - POs with low course count (coverage risk) - Outcomes primarily 1-ratings (peripheral treatment).

# CHAPTER 12: ATTAINMENT OF COURSE OUTCOME (CO)

## 12.1 Definition

Course Outcome (CO) Attainment measures the extent to which students achieve specific learning outcomes. It combines direct assessment (80% - student performance) and indirect assessment (20% - student feedback) to provide a comprehensive evaluation.

## 12.2 Assessment Tools

**Direct Assessment (80%):** - CIE-I: Class test 1 (Week 4-5) - CIE-II: Class test 2 (Week 10-11) - MSE: Mid-semester exam (Week 7-8, half syllabus) - Practicals: Weekly hands-on work - SEE: University semester end exam

**Indirect Assessment (20%):** - Course Exit Survey (CESA): Last week of semester

## 12.3 CO Attainment Formula

**CO Attainment = (Average Direct Attainment × 0.80) + (Average Indirect Attainment × 0.20)**

## 12.4 Threshold and Target

| Level | Performance | Interpretation |
|---|---|---|
| **3.0** | 76-100% students >50% marks | Excellent |
| **2.0** | 56-75% students >50% marks | Satisfactory |
| **1.0** | 40-55% students >50% marks | Needs Improvement |
| **<1.0** | <40% students >50% marks | Unsatisfactory |

**Standard Target: 2.0** (56-75% students score >50% marks)

## 12.5 Calculation Example

**Course: Data Structures | CO3: Analyze data structures**

**Direct Assessment (80%):** - CIE-I: 2.6 | CIE-II: 2.7 | MSE: 2.5 | Practicals: 2.8 | SEE: 2.6 - Average Direct = (2.6 + 2.7 + 2.5 + 2.8 + 2.6) / 5 = **2.64**

**Indirect Assessment (20%):** - Course Exit Survey Average = **2.8**

**Overall CO3 Attainment:** = (2.64 × 0.80) + (2.8 × 0.20) = 2.11 + 0.56 = **2.67 (Level 2.7 - Satisfactory)**

## 12.6 Action Plan: Attained COs (≥2.0)

| CO | Target | Attainment | Gap | Action |
|---|---|---|---|---|
| CO1 | 2.0 | 3.0 | +1.0 | Set higher target next year |
| CO2 | 2.0 | 2.2 | +0.2 | Maintain current approach |

| CO | Target | Attainment | Gap | Action |
|---|---|---|---|---|
| CO3 | 2.0 | 2.5 | +0.5 | Maintain current approach |
| CO4 | 2.0 | 3.0 | +1.0 | Set higher target next year |

## 12.7 Action Plan: Unattained COs (<2.0)

| CO | Target | Attainment | Gap | Action |
|---|---|---|---|---|
| CO1 | 2.0 | 1.0 | -1.0 | Conduct remedial classes |
| CO2 | 2.0 | 1.5 | -0.5 | Organize extra tutorials |
| CO3 | 2.0 | 0.8 | -1.2 | Arrange expert lectures |
| CO4 | 2.0 | 1.0 | -1.0 | Conduct co-curricular activities |

## 12.8 Interventions for Below-Target COs

**Remedial Classes (Gap >1.0):** - 4-6 weeks after semester - Focus on misconceptions and fundamentals - 1-2 sessions per week - Target: 70% students achieve ≥2.0 in next offering

**Extra Tutorials (Gap 0.5-1.0):** - 1-2 sessions during semester - Problem-solving and practice - After each assessment

**Expert Lectures:** - Industry professionals or specialists - 2-3 sessions per semester - Current practices and real-world applications

**Co-Curricular Activities:** - Workshops, competitions, projects - Enhance engagement and skills - Monthly or semester-long

## 12.9 Documentation

Faculty maintains in Record Book: - CO definitions and assessment tools - Target attainment levels - Attainment calculations - Direct and indirect data - Action plans - Evidence of interventions

Department submits to PAQIC by end of June: - CO attainment summary (all courses, all semesters) - Gap analysis - Action plans for below-target COs - Implementation evidence

## 12.10 Continuous Improvement Process

**Year 1:** Establish baselines | Identify gaps | Create action plans **Year 2:** Implement actions | Assess effectiveness | Adjust strategies **Year 3+:** Sustain improvements | Monitor trends | Share best practices

# CHAPTER 13: ATTAINMENT OF PROGRAMME OUTCOME (PO)

## 13.1 Definition

Programme Outcome Attainment is the measurable extent to which students have achieved the defined Program Outcomes and Program Specific Outcomes by the end of their program. PO attainment is calculated through systematic aggregation of Course Outcome performance using CO-PO mapping and combined with indirect stakeholder feedback.

## 13.2 PO Attainment Calculation Formula

### 13.2.1 Core Formula

**Direct PO Attainment = Σ(Overall CO Attainment × PO Mapping Factor) / Σ Maximum PO Mapping Factor**

Where: - Overall CO Attainment = Final CO attainment value (0 to 3.0 scale) - PO Mapping Factor = Correlation rating between CO and PO (3, 2, 1, or 0) - Maximum PO Mapping Factor = Highest possible correlation (always 3 for present correlations)

### 13.2.2 Overall Attainment Calculation

**Overall Attainment = Direct Attainment (80%) + Indirect Attainment (20%)**

## 13.3 Step-by-Step PO Attainment Calculation

### 13.3.1 Step 1: Calculate Subject-Level Direct Attainment

For each subject/course contributing to a PO:

**Subject Direct Attainment for PO_i = Σ(CO_j Attainment × PO_i Mapping Factor) / Σ Maximum Mapping Factors**

**Process:** 1. List all Course Outcomes (COs) in the subject 2. For each CO, obtain Overall CO Attainment value 3. For each CO, identify its mapping factor to PO_i from CO-PO matrix 4. Multiply: CO Attainment × PO_i Mapping Factor 5. Sum all products 6. Divide by sum of maximum mapping factors (3 per CO)

### 13.3.2 Step 2: Calculate Program-Level Direct Attainment

After calculating subject-level attainment for all semesters/subjects:

**Program Direct Attainment for PO_i = Average of all Subject Direct Attainments for PO_i across all semesters**

Take arithmetic mean of subject-level attainments.

### 13.3.3 Step 3: Collect Indirect Attainment Data

**Methods:** - Program Exit Survey: - Survey all graduating students before graduation -

Questions directly assess each PO - Example: "I can apply engineering knowledge to solve complex problems" - Calculate % of students agreeing strongly/somewhat - This becomes Indirect Attainment for relevant POs

Alumni Survey: - Contact graduates 1-5 years post-graduation - Ask about PO-relevant competencies currently used - Example: "I regularly use problem-solving skills" - Provides validation of long-term impact - Contributes to PEO assessment

Employer Feedback: - Survey employers hiring graduates - Ask about competency levels of recent graduates - Example: "Our recent hires from this program can analyze problems effectively" - Identifies skill gaps - Guides curriculum improvements

Industry Expert Input: - Advisory board meetings with professionals - Input on contemporary practices - Validation that POs remain relevant - Recommendations for emerging skills

**Calculation:** Average of survey responses converted to 0-3.0 scale

### 13.3.4 Step 4: Calculate Overall PO Attainment

**Overall PO Attainment = (Direct Attainment × 0.80) + (Indirect Attainment × 0.20)**

- Direct Attainment: 80% weight (objective student performance)
- Indirect Attainment: 20% weight (stakeholder perception and feedback)

## 13.4 Worked Example: Complete Calculation

### 13.4.1 Scenario

Subject: Data Structures (CSE Department) - 4 Course Outcomes (CO1, CO2, CO3, CO4) - Computing PO1 (Engineering Knowledge) attainment

### 13.4.2 Subject-Level Calculation

**CO Data:**

| CO | Overall CO Attainment | PO1 Mapping Factor | Product (CO × Factor) |
|---|---|---|---|
| CO1 | 2.8 | 3 | 2.8 × 3 = 8.4 |
| CO2 | 2.9 | 3 | 2.9 × 3 = 8.7 |
| CO3 | 2.5 | 2 | 2.5 × 2 = 5.0 |
| CO4 | 2.6 | 2 | 2.6 × 2 = 5.2 |

**Subject Direct Attainment for PO1:**

= (8.4 + 8.7 + 5.0 + 5.2) / (3 + 3 + 2 + 2) = 27.3 / 10 = **2.73**

### 13.4.3 Program-Level Calculation

Repeat process for all subjects (semesters) addressing PO1:

**Semester 1 Subjects:** - Subject A (Data Structures): 2.73 - Subject B (Database): 2.65 -

Subject C (Programming): 2.80

**Semester 2 Subjects:** - Subject D (Web Dev): 2.55 - Subject E (Design): 2.75

**Program Direct Attainment for PO1:**

= (2.73 + 2.65 + 2.80 + 2.55 + 2.75) / 5 = 13.48 / 5 = **2.70 (Direct Attainment)**

### 13.4.4 Overall PO Attainment

**Indirect Attainment** (from surveys) = 3.0

**Overall PO1 Attainment:**

= (2.70 × 0.80) + (3.0 × 0.20) = 2.16 + 0.60 = **2.76 → Level 2.7 (Satisfactory)**

## 13.5 PO Attainment Levels and Interpretation

| Attainment Range | Level | Interpretation | Status |
|---|---|---|---|
| 2.7 - 3.0 | 3.0 | Excellent - Outstanding achievement | Target Exceeded |
| 2.3 - 2.6 | 2.5 | Satisfactory - Adequate achievement | Target Met |
| 1.5 - 2.2 | 2.0 | Needs Improvement - Partially achieved | Below Target |
| < 1.5 | 1.0 | Unsatisfactory - Significantly below target | Critical Gap |

## 13.6 Direct, Indirect, and Overall PO Attainment Calculation

**Direct, Indirect, and Overall PO Attainment Calculation**

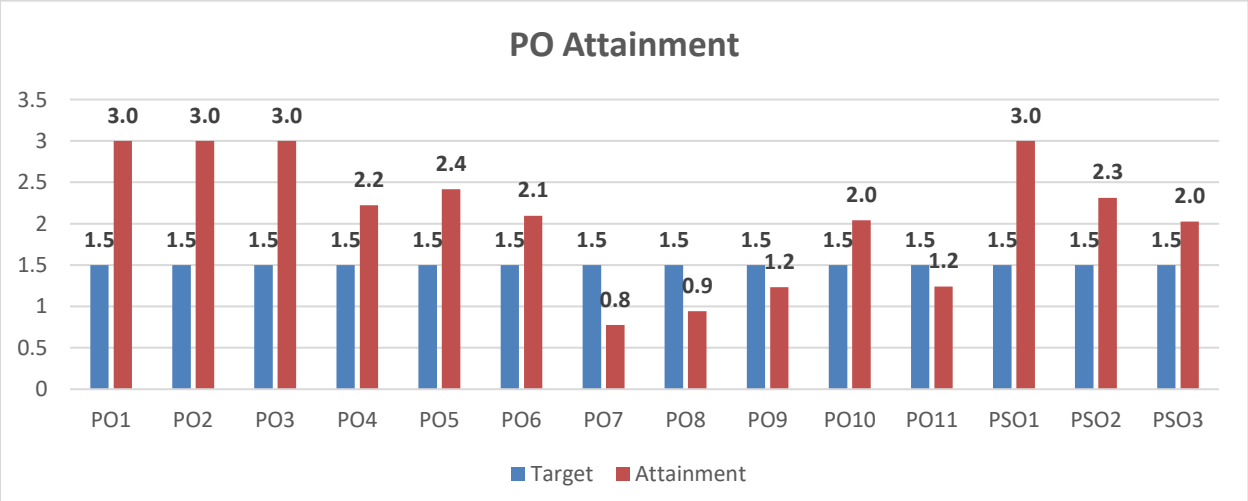
| PO | Direct Attainment (A) | 80% of Direct | Indirect Attainment (B) | 20% of Indirect | **Overall (A+B)** |
|---|---|---|---|---|---|
| **PO1** | 3.00 | 2.40 | 3.00 | 0.60 | **3.0** |
| **PO2** | 3.00 | 2.40 | 3.00 | 0.60 | **3.0** |
| **PO3** | 3.00 | 2.40 | 3.00 | 0.60 | **3.0** |
| **PO4** | 2.03 | 1.62 | 3.00 | 0.60 | **2.2** |
| **PO5** | 2.27 | 1.82 | 3.00 | 0.60 | **2.4** |
| **PO6** | 1.90 | 1.52 | 3.00 | 0.60 | **2.1** |
| **PO7** | 0.22 | 0.18 | 3.00 | 0.60 | **0.8** |
| **PO8** | 0.43 | 0.34 | 3.00 | 0.60 | **0.9** |
| **PO9** | 0.79 | 0.63 | 3.00 | 0.60 | **1.2** |
| **PO10** | 1.80 | 1.44 | 3.00 | 0.60 | **2.0** |

| PO | Direct Attainment (A) | 80% of Direct | Indirect Attainment (B) | 20% of Indirect | **Overall (A+B)** |
|---|---|---|---|---|---|
| **PO11** | 0.60 | 0.48 | 3.00 | 0.60 | **1.1** |
| **PSO1** | 3.00 | 2.40 | 3.00 | 0.60 | **3.0** |
| **PSO2** | 2.10 | 1.68 | 3.00 | 0.60 | **2.3** |
| **PSO3** | 1.80 | 1.44 | 3.00 | 0.60 | **2.0** |

**Institution Target Threshold = 1.50**

## 13.6.2 Gap Analysis and Attainment Status

| PO | Target | Attainment | Gap | Target Attained | Action Required |
|---|---|---|---|---|---|
| PO1 | 1.50 | 3.0 | +1.5 | ✅ YES | Maintain |
| PO2 | 1.50 | 3.0 | +1.5 | ✅ YES | Maintain |
| PO3 | 1.50 | 3.0 | +1.5 | ✅ YES | Maintain |
| PO4 | 1.50 | 2.2 | +0.7 | ✅ YES | Monitor |
| PO5 | 1.50 | 2.4 | +0.9 | ✅ YES | Monitor |
| PO6 | 1.50 | 2.1 | +0.6 | ✅ YES | Monitor |
| PO7 | 1.50 | 0.8 | -0.7 | ❌ NO | **Action Plan** |
| PO8 | 1.50 | 0.9 | -0.6 | ❌ NO | **Action Plan** |
| PO9 | 1.50 | 1.2 | -0.3 | ❌ NO | **Action Plan** |
| PO10 | 1.50 | 2.0 | +0.5 | ✅ YES | Monitor |
| PO11 | 1.50 | 1.1 | -0.4 | ❌ NO | **Action Plan** |
| PSO1 | 1.50 | 3.0 | +1.5 | ✅ YES | Maintain |
| PSO2 | 1.50 | 2.3 | +0.8 | ✅ YES | Monitor |
| PSO3 | 1.50 | 2.0 | +0.5 | ✅ YES | Monitor |



## 13.7 PO Gap Identification

**Alert Threshold:** PO Attainment < 1.50

When PO attainment falls below 1.50: - Flag as requiring improvement - Trigger PAQIC review - Initiate root cause analysis - Develop action plan

**Gap Analysis Process:**

**Step 1:** Identify which courses primarily address the PO with attainment <1.50

**Step 2:** Examine CO attainment in those courses - Are relevant COs also showing low attainment? - Or is problem with CO-PO mapping?

**Step 3:** Investigate course-level issues - Teaching methodology adequate? - Assessment aligned to outcomes? - Student prerequisites sufficient? - Time allocation adequate?

**Step 4:** Examine program-level coverage - How many courses address this PO? - Are all with high, medium, and low correlations? - Is coverage sufficient and distributed?

## 13.8 Program-Level Data Analysis

**Compilation of All Course Attainment Data:** - Collect CO attainment from all courses in program - All semesters (Year 1, 2, 3, 4) - All faculty teaching the course

**Calculation of Aggregate PO Attainment:** - For each PO, apply aggregation formula - Weight by course delivery frequency and enrollment - Account for multiple sections of same course

**Trend Analysis (3-5 year trends):** - Plot PO attainment over years - Identify improving outcomes (good!) - Identify declining outcomes (concerning) - Identify stable outcomes (plateau)

**Comparison with Previous Years:** - Document improvement or decline since last year - Attribute changes to specific actions taken - Validate effectiveness of improvements

**Identification of Improvement Areas:** - POs consistently below 1.50 - POs showing decline trend - POs with low indirect assessment scores - Gaps between direct and indirect assessment

## 13.9 PAQIC Review Process

**Meeting Schedule:** Typically June-July after all data compiled

**Participants:** - Program Coordinator (Chair) - Faculty representatives (3-4) - Student representative - IQAC Coordinator - External expert (occasionally)

**Data Presentation:** - Summary of all PO attainment levels - Visualization (charts, graphs) - Comparison to previous years - Identification of gaps and strengths

**Collaborative Analysis:** - Faculty discuss implications - Identify likely root causes - Brainstorm potential solutions - Consider feasibility and resource requirements

**Consensus Building:** - Reach agreement on identified problems - Develop shared

understanding - Commit to action items

**Action Plan Development:** - Specific actions for each below-target PO - Responsible persons assigned - Timeline for implementation - Resource requirements - Success metrics

## 13.10 PO-Wise Report Preparation

**Summary of Attainment by PO:** - Attainment level for each of 11 POs - Comparison to target (1.50) - Trends over 3-5 years

**Strengths:** - POs consistently above target - Improving trends - Positive indirect feedback - Innovative teaching methods - High employer satisfaction

**Challenges:** - POs below 1.50 - Declining trends - Gaps between student and employer perception - Resource constraints - Coverage gaps

**Recommendations:** - Curriculum modifications - Teaching methodology changes - Assessment improvements - Resource needs - Professional development

## 13.11 Departmental Action Planning

**Priority Setting:** - Focus on lowest-attaining POs first - Address POs showing significant decline - Don't attempt too many changes simultaneously

**Resource Allocation:** - Budget for improvements - Training for faculty - Equipment or software if needed - Time for curriculum redesign

**Faculty Assignment:** - Identify faculty leaders for each improvement - Provide support and mentoring - Recognize contributions

**Implementation Timeline:** - When to implement changes - Pilot testing before full rollout - Phased implementation if needed

**Monitoring and Evaluation Plan:** - How often to check progress - Data collection methods - Decision points for adjustment - Timeline for full evaluation

## 13.12 Documentation and Institutional Reporting

**Annual Quality Assurance Report:** - Department summarizes PO attainment - Documents actions taken - Reports results of actions - Identifies next year priorities

**Submission to IQAC:** - PAQIC reports feed into IQAC - IQAC aggregates across programs - Institutional-level patterns identified

**Accreditation Body Communication:** - NBA requirements - NAAC evidence - ABET documentation - Public accountability

**Stakeholder Communication:** - Share results with faculty - Communicate to students how program improved - Update employers on curriculum relevance - Celebrate achievements and progress

# CHAPTER 14: AI OPEN TOOLS FOR OUTCOME BASED EDUCATION (UPDATED)

## 14.1 Introduction to AI Tools in OBE

Artificial Intelligence and open-source tools can significantly enhance OBE implementation by automating routine tasks, analyzing large datasets, providing insights, and supporting faculty and student learning.

## 14.2 Open AI Tools for OBE Implementation

### 14.2.1 ChatGPT / OpenAI GPT Models

**Uses in OBE:** - Generate course outcome descriptions aligned to Bloom's Taxonomy - Provide feedback on outcome quality and alignment - Create assessment questions from course content - Generate multiple versions of quiz questions - Provide sample rubrics and evaluation criteria

**Access:** https://chat.openai.com (Free tier available)

**Example Prompt:** "Generate 5 course outcomes for a Data Structures course at Level 3 (Apply) in Bloom's Taxonomy using action verbs. Ensure they are SMART and aligned to software design."

### 14.2.2 Magic School AI

**Purpose:** AI-powered educational content platform for teachers

**Uses in OBE:** - Generate differentiated assessment questions - Create rubrics aligned to learning outcomes - Design lesson plans aligned to specific outcomes - Generate formative assessment tools - Create student-friendly outcome explanations - Design scaffolding and support materials

**Access:** https://www.magicschool.ai (Free tier available)

**OBE Application:** - Quickly design outcome-aligned assessments - Create multiple versions for different student needs - Generate clear rubrics for consistent evaluation - Develop supporting materials for student learning

**Specific Feature for OBE:** - Rubric builder: Input learning outcome → generates detailed rubric - Assessment generator: Input outcome and topic → generates quiz questions - Lesson planner: Align lessons to specific outcomes

### 14.2.3 Gamma App

**Purpose:** AI presentation and document creation tool

**Uses in OBE:** - Create visually stunning presentations for outcome communication - Design outcome documentation and handouts - Generate data visualizations for attainment reports - Create professional slides for PAQIC presentations - Design infographics explaining OBE concepts - Develop stakeholder communication materials

**Access:** https://gamma.app (Free tier available)

**OBE Application:** - Present OBE framework to stakeholders - Create visually appealing outcome documentation - Design data visualization dashboards - Prepare professional reports for accreditation bodies

**Specific Feature for OBE:** - Data import: Upload attainment data → Gamma creates visualizations - Template library: Pre-designed OBE-relevant templates - One-click design: Simple, professional output - Real-time collaboration: Faculty work together on presentations

**Example Use:** - Import PO attainment data from spreadsheet - Gamma automatically creates charts, graphs, dashboards - Faculty edits text, adds commentary - Generates professional presentation or document

### 14.2.4 Google Forms + Google Sheets

**Uses in OBE:** - Design course exit surveys (CESA) and program exit surveys - Collect alumni and employer feedback - Automatic data compilation and basic analysis - Create visualizations (pie charts, bar graphs) - Real-time response tracking

**Access:** https://forms.google.com / https://sheets.google.com (Free with Google account)

**OBE Application:** - Create outcome achievement surveys - Analyze attainment data - Generate reports for PAQIC

### 14.2.5 Mermaid Diagram Editor

**Uses in OBE:** - Create OBE pyramid diagrams - Visualize assessment cycles - Design flowcharts for processes - Create concept maps - Generate CO-PO mapping visuals

**Access:** https://mermaid.live (Free, no login required)

**OBE Application:** - Document OBE framework visually - Create process flowcharts - Design curriculum mapping visualizations

### 14.2.6 Canva

**Uses in OBE:** - Design course syllabi and handouts - Create presentation slides for outcome communication - Design posters for assessment information - Create infographics for OBE concepts - Professional visual materials

**Access:** https://www.canva.com (Free tier available)

**OBE Application:** - Make outcome descriptions visually appealing - Create faculty training materials - Design student-facing outcome communication

### 14.2.7 Microsoft Excel / Google Sheets (Advanced)

**Uses in OBE:** - CO and PO attainment calculation spreadsheets - Automated formulas for weighted averaging - Trend analysis over multiple years - Heat maps showing performance patterns - Dashboard creation for quick insights

**Access:** Free (Google Sheets) or existing licenses (Excel)

**OBE Application:** - Centralized attainment data management - Automated calculations - Easy updating and tracking

### 14.2.8 LibreOffice Draw

**Uses in OBE:** - Create process flowcharts - Design curriculum structure diagrams - Document OBE framework visually - Create assessment process maps - Design organizational charts

**Access:** https://www.libreoffice.org (Free, open-source)

**OBE Application:** - Design institutional OBE processes - Create visual documentation - Share process improvements

### 14.2.9 Grammarly

**Uses in OBE:** - Check course outcome wording for clarity - Ensure consistent terminology - Improve writing quality of syllabi - Grammar and style checking for all documents - Professional document preparation

**Access:** https://www.grammarly.com (Free version available)

**OBE Application:** - Polish course outcome language - Ensure quality documentation - Professional manual preparation

## 14.3 Data Analysis and Visualization Tools

### 14.3.1 Python (Free, Open-Source)

**Uses in OBE:** - Analyze attainment data at scale - Create visualizations (matplotlib, seaborn) - Statistical analysis of trends - Automated report generation - Data cleaning and compilation

**Access:** https://www.python.org (Free download)

**OBE Application:** - Complex attainment calculations - Trend analysis across years - Predictive analytics for student success

### 14.3.2 R Programming

**Uses in OBE:** - Statistical analysis of assessment data - Generate publication-quality graphs - Trend analysis and forecasting - Data visualization - Automated reporting

**Access:** https://www.r-project.org (Free, open-source)

**OBE Application:** - Rigorous statistical analysis of outcomes - Professional visualization - Academic-quality reporting

## 14.4 Collaboration and Communication Tools

### 14.4.1 Notion

**Uses in OBE:** - Create shared OBE documentation - Maintain outcome databases - Track assessment calendar - Collaborative rubric development - Faculty resource center

**Access:** https://www.notion.so (Free tier available)

**OBE Application:** - Centralized OBE documentation - Collaborative faculty workspace - Accessible to all stakeholders

### 14.4.2 Padlet

**Uses in OBE:** - Collect student feedback on outcomes - Collaborative course design - Faculty discussion and idea sharing - Visual outcome mapping - Interactive assessment planning

**Access:** https://padlet.com (Free tier available)

**OBE Application:** - Collaborative outcome development - Faculty engagement in OBE process - Creative brainstorming

## 14.5 Survey and Feedback Tools

### 14.5.1 Qualtrics (Limited Free) / SurveySparrow

**Uses in OBE:** - Professional survey design - Program exit surveys - Alumni surveys - Employer feedback collection - Outcome-specific questions - Automated analysis and reporting

**Access:** Qualtrics (paid, limited free) / SurveySparrow (free tier)

**OBE Application:** - Comprehensive indirect assessment - Professional data collection -

Advanced analytics

## 14.6 Practical Implementation Examples

### Example 1: Using Magic School AI for Rubric Generation

**Process:** 1. Go to Magic School AI 2. Input learning outcome (e.g., "Apply OOP principles to design software") 3. Specify assessment context (project, exam, etc.) 4. AI generates detailed rubric with performance levels 5. Faculty reviews, customizes if needed 6. Use in assessment

**Benefit:** Saves time; ensures alignment; professional quality

### Example 2: Using Gamma for Attainment Visualization

**Process:** 1. Export PO attainment data to spreadsheet 2. Upload to Gamma app 3. Select chart type (bar, trend, heatmap) 4. Gamma auto-generates professional visualization 5. Add commentary and narrative 6. Share with PAQIC and stakeholders

**Benefit:** Professional-looking reports; quick generation; impressive presentations

### Example 3: Using Google Forms for CESA

**Process:** 1. Create Google Form for course exit survey 2. Include questions on each course outcome 3. Share with students via LMS 4. View responses in real-time 5. Export to Google Sheets for analysis 6. Create charts/graphs for PAQIC

**Benefit:** Easy data collection and analysis; visual insights

### Example 4: Using Mermaid for Process Documentation

**Process:** 1. Open Mermaid.live 2. Write diagram code for OBE processes 3. Generate visual representation 4. Export as image 5. Include in manual or presentations

**Benefit:** Clear visual documentation; easily shareable

## 14.7 Recommended Tool Combinations for Specific OBE Tasks

**Task: Design Assessment Rubric** - Magic School AI (generate rubric) → Canva (design visual version) → Grammarly (polish language)

**Task: Present PO Attainment Data** - Google Sheets (data management) → Gamma (create visualization) → Gamma or Canva (presentation design)

**Task: Create Outcome Documentation** - ChatGPT (draft outcomes) → Grammarly

(edit) → Gamma or Canva (design) → Notion (store)

**Task: Visualize OBE Framework** - Mermaid (create diagram) → Canva (enhance design) → Gamma (presentation slide)

**Task: Collect and Analyze Feedback** - Google Forms (survey) → Google Sheets (analyze) → Gamma (visualize) → Canva (report design)

## 14.8 Best Practices for Using AI Tools

**1. Faculty Validation Required:** AI tools generate suggestions; faculty must validate appropriateness and accuracy before use.

**2. Ethical Use:** Disclose when AI is used; maintain academic integrity; don't replace professional judgment.

**3. Data Privacy:** Be cautious with student data; use secure platforms; follow institutional privacy policies.

**4. Training and Support:** Provide faculty training on tool use; create quick-start guides; designate OBE champions.

**5. Gradual Adoption:** Start with simple tools; expand as comfort increases; don't overwhelm with too many tools.

## 14.9 Recommended Tool Stack for OBE at Our Institution

**Priority 1 - Essential Tools:** - Google Forms (surveys) - Google Sheets (data management) - Magic School AI (rubric and assessment generation) - Gamma (data visualization)

**Priority 2 - Enhancement Tools:** - ChatGPT (outcome writing support) - Canva (visual design) - Mermaid (process diagrams)

**Priority 3 - Advanced Tools:** - Python (advanced analysis) - R (statistical analysis) - Notion (shared workspace)

## 14.10 Implementation Timeline

**Phase 1 (Immediate - Month 1):** - Set up Google Forms and Google Sheets - Faculty training on Magic School AI - Start using AI for rubric and assessment generation - Begin data collection and management

**Phase 2 (Short-term - Months 2-3):** - Introduce Gamma for data visualization - Create attainment dashboards - Develop presentation templates - Train PAQIC on new tools

**Phase 3 (Medium-term - Months 4-6):** - Expand to Canva for professional design - Set up Mermaid for process documentation - Implement Notion for shared OBE workspace - Consolidate tools and processes

**Phase 4 (Long-term - Months 6-12):** - Explore Python/R for advanced analysis -

Develop automated reporting systems - Continuous training and refinement - Scale tools across all programs

## 14.11 Support and Resources

**Training:** - Faculty workshops on each tool (30 minutes each) - Quick-start video guides - Written user manuals - Peer mentoring program - OBE champion available for questions

**Access:** - College provides licenses where needed (Gamma Pro, etc.) - Free tools prioritized for cost-effectiveness - IT support for technical issues - Troubleshooting guide

**Documentation:** - Tool usage manual for OBE - Video tutorials on YouTube channel - Troubleshooting guides - Best practice sharing

## 14.12 Conclusion: The Future of OBE with AI

AI and open tools democratize access to professional-quality OBE practices. Faculty no longer need advanced technical skills to create compelling assessments, visualize complex data, or communicate results effectively.

By thoughtfully integrating Magic School AI, Gamma, and complementary tools, Dr. D. Y. Patil Pratisthan's College can significantly enhance OBE implementation while keeping faculty workload manageable and outcomes data accessible to all stakeholders.