

Academic Benchmarking Report

Learning Outcomes Comparison with International Engineering Standards

1. Introduction

This report presents a benchmarking analysis of the Learning Outcomes (LOs) for the Refrigeration and Air Conditioning Engineering program against internationally recognized standards such as ABET and CDIO frameworks. The aim is to evaluate alignment, identify strengths, and highlight gaps for continuous improvement and international accreditation readiness.

2. Learning Outcomes Structure

The program outcomes are categorized into three main domains:

- Knowledge
 - Values
 - Competencies
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3. Benchmarking with ABET Standards

3.1 Knowledge Domain

The program demonstrates strong alignment with ABET criteria in:

- Engineering fundamentals (mathematics, thermodynamics, fluid mechanics, heat transfer)
- HVAC systems understanding
- Engineering standards and environmental considerations

Evaluation: High alignment ($\approx 85\%$)

Gap Identified:

- Limited integration of modern topics such as Artificial Intelligence and smart systems.
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3.2 Values Domain

The program outcomes strongly align with ABET expectations in:

- Engineering ethics
- Professional responsibility
- Environmental and safety awareness
- Teamwork and collaboration

Evaluation: Very high alignment ($\approx 95\%$)

3.3 Competencies Domain

The competencies closely match ABET student outcomes:

- Problem-solving skills
- Engineering design capabilities
- Experimental analysis
- Use of engineering tools and software
- Communication skills
- Lifelong learning



Evaluation: Excellent alignment ($\approx 90-95\%$)

4. Benchmarking with CDIO Framework

The CDIO model focuses on four stages:

- Conceive
- Design
- Implement
- Operate

Findings:

- Design: Fully covered
- Implement: Partially covered
- Operate: Fully covered
- Conceive: Weak representation

Conclusion: The program needs improvement in innovation, idea generation, and system conceptualization skills.

5. Benchmarking with Top International Universities

Comparison with leading institutions indicates:

Strengths:

- Strong theoretical foundation
- Practical engineering skills
- Laboratory and applied competencies

Weaknesses:

- Limited exposure to:

- Innovation and entrepreneurship
- Advanced digital tools and AI applications
- Sustainability engineering in depth
- Leadership and advanced project management

6. Gap Analysis

Area	Current Status	Required Improvement
Innovation	Limited	Add entrepreneurship & innovation courses
Digital Skills	Basic	Integrate AI, simulation, data analysis
Sustainability	General	Add green HVAC & carbon reduction
Leadership	Not explicit	Include leadership training

7. Overall Evaluation

Domain	Alignment
Knowledge	85%
Values	95%
Competencies	90–95%
Overall	~90% (Strong International Alignment)

8. Recommendations

1. Introduce courses in AI and smart HVAC systems.
2. Strengthen innovation and entrepreneurship education.
3. Enhance sustainability focus with modern environmental challenges.
4. Develop leadership and project management skills.
5. Increase industry collaboration and real-world projects.

9. Conclusion

The program demonstrates strong compatibility with international standards, particularly ABET. With targeted improvements in innovation, digital transformation, and sustainability, the program can achieve full alignment with leading global engineering institutions and enhance its chances for international accreditation.

