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Original Article

CO–PO Mapping and Bloom's Taxonomy Alignment for CPE-BS-151: Engineering Physics, Sikkim Institute of Science and Technology, Chisopani, South Sikkim, Sikkim-737126

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Abstract

Engineering Physics forms the scientific foundation for engineering education by integrating fundamental principles of electromagnetism and wave phenomena with practical engineering applications. This paper presents a systematic mapping of Course Outcomes (COs) of CPE-BS-151: Engineering Physics with Program Outcomes (POs), along with Bloom's Taxonomy alignment. The study ensures outcome-based education (OBE) compliance by establishing measurable learning objectives, competency-based assessment alignment, and cognitive level distribution. The CO–PO mapping matrix demonstrates strong correlation with engineering problem-solving, analytical skills, and application of electromagnetic theory in real-world contexts.

Keywords: *Outcome-Based Education, CO–PO Mapping, Bloom's Taxonomy, Electromagnetism, Maxwell's Equations, Engineering Physics.*

Introduction

Engineering Physics provides conceptual understanding of electromagnetism, magnetostatics, dielectric materials, Maxwell's equations, and electromagnetic waves. These topics are fundamental for electrical engineering, electronics, communication systems, and applied physics domains. Outcome-Based Education (OBE) requires measurable Course Outcomes (COs) aligned with Program Outcomes (POs). Bloom's Taxonomy further categorizes learning objectives into hierarchical cognitive levels ensuring structured skill development. Engineering Physics serves as a bridge between fundamental science and engineering applications [1-5]. Topics such as:

- Electrostatics and Magnetostatics
- Dielectric and Magnetic Materials
- Maxwell's Equations
- Electromagnetic Waves
  are indispensable in understanding modern technologies including:
- Power transmission systems
- Electronic circuit design
- Wireless communication
- Optical fiber communication
- Microwave engineering

Outcome-Based Education (OBE) emphasizes measurable learning outcomes rather than traditional content coverage [6-10]. According to OBE principles, each course must clearly define:

- **Course Outcomes (COs)** – What students should be able to do at the end of the course.
- **Program Outcomes (POs)** – Broader abilities students acquire upon completion of the engineering program.

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Alignment between COs and POs ensures academic coherence and quality assurance.

Course Outcomes (COs)

Based on the syllabus of CPE-BS-151 [11-15]:

CO1: Understand electrostatics and magnetostatics in vacuum and linear dielectric media for engineering applications.

CO2: Explain Faraday's law in terms of electromagnetic fields under quasi-static approximation.

CO3: Evaluate Maxwell's equations in different media in electromagnetic theory.

CO4: Explain displacement current and apply Maxwell's equations in various media.

Program Outcomes (POs) [16-20]

Standard engineering Program Outcomes (as per NBA/ABET model):

PO1: Engineering knowledge
PO2: Problem analysis
PO3: Design/development of solutions
PO4: Conduct investigations
PO5: Modern tool usage
PO6: Engineer and society
PO7: Environment and sustainability
PO8: Ethics
PO9: Individual and teamwork
PO10: Communication
PO11: Project management
PO12: Life-long learning

4. CO–PO Mapping Matrix [21-25]

(Scale: 3 – Strong, 2 – Moderate, 1 – Low)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	1	-	-	1	-	2
CO2	3	3	2	2	1	-	-	-	-	1	-	2
CO3	3	3	3	2	2	-	-	-	-	1	-	2
CO4	3	3	3	2	2	-	-	-	-	1	-	2

Interpretation:

Strong correlation with PO1 (Engineering Knowledge) and PO2 (Problem Analysis).

Maxwell's equations significantly support PO3 (Design and Development).

Moderate support for investigation and tool usage.

Bloom's Taxonomy Mapping [26-30]

CO	Bloom's Level	Description
CO1	L2 (Understand) & L3 (Apply)	Explain electrostatic and magnetostatic principles and apply in dielectric problems
CO2	L2 (Understand) & L3 (Apply)	Interpret Faraday's law and solve EMF problems
CO3	L4 (Analyze)	Analyze Maxwell's equations in various media
CO4	L4 (Analyze) & L5 (Evaluate)	Evaluate displacement current and EM wave propagation

Cognitive Distribution:

Remember & Understand: 25%
Apply: 30%
Analyze: 30%
Evaluate: 15%

This ensures higher-order thinking skills (HOTS).

Assessment Alignment [31-35]

Formative Assessment (40%)
Quiz I & II → L1–L3
Sessional I & II → L2–L4
Summative Assessment (60%)
Semester-end examination → L3–L5

Assessment tools align with CO attainment and Bloom's cognitive levels.

Significance of CO–PO Mapping [36-40]

Ensures curriculum transparency
Supports accreditation requirements (NBA/NAAC)
Enhances measurable learning outcomes
Aligns teaching–learning strategies with evaluation

Conclusion

The CO–PO mapping and Bloom's Taxonomy alignment for CPE-BS-151 demonstrate strong integration of engineering knowledge, analytical skills, and electromagnetic theory application. The course effectively builds foundational competencies required in electrical engineering, communication systems, and applied physics domains. The structured mapping supports outcome-based education and continuous quality improvement.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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