1. Introduction

• The Physical Measurements and Instrumentation (PMI) course covers analog & digital electronics and LabVIEW programming.

• In the second half of PMI, students work on ill-structured capstone projects, where they apply their newly learned knowledge to automate experiments that were learned in previous advanced labs.

• The PMI capstones provide a context in which to study how students solve ill-structured problems.

2. The PMI Course

Analog & Digital Electronics + LabVIEW Programming → Capstone Projects

1st Half 2nd Half

3. Examples of PMI Capstone Projects

• Measuring the Speed of Light

• Saturated Absorption Spectroscopy

• SQUID (Superconducting Quantum Interference Device)

• X-Ray Diffraction

• Chaotic Circuits

4. Ill-Structured Nature of the Capstone Projects

<table>
<thead>
<tr>
<th>Characteristics of ill-structured problems</th>
<th>Capstone Projects in PMI</th>
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<tr>
<td>One or more problem elements are unknown</td>
<td>Unclear which electronic components, measurement &amp; analysis technique should be used</td>
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<tr>
<td>Require integration of content domains</td>
<td>Require integration of knowledge from electronics, instrumentation, programming and physics</td>
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<td>Solutions not predictable or convergent</td>
<td>Several different solutions are possible depending on the electronic equipment and analysis technique used</td>
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<td>Typically encountered in professional settings</td>
<td>For example, in research labs, we do experimental measurements, planning, debugging, etc.</td>
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5. Students’ Learning Outcomes

The capstone projects offer students excellent opportunities:

• To learn or re-learn physics concepts

• To write LabVIEW programs and build circuits on the NI ELVIS II prototyping board

• To see usefulness of electronics in physics experiments

6. Ongoing Work

Study to find out how students solve ill-structured problems

References
