Research Experience for Teachers

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**EET130 Introduction to Electronic Circuits**

**Strain Gauges: Present and Future**

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| Stage 1 Desired Results |
| Established Goals* Analyze Series-Parallel DC Circuits to find resistance, current, voltage, and power (course objective)
	+ Analyze a Wheatstone Bridge
	+ Describe principles of operation of a Wheatstone Bridge used with a strain gage in structural monitoring.
* Build and take measurements in Series-Parallel DC Circuits (course objective)
	+ Given the circuit drawing, build a Wheatstone Bridge on a breadboard
	+ Measure resistance, current, and voltage in the Wheatstone Bridge
* Innovative and Critical Thinking -Integrating knowledge to analyze problems using different modes of thinking (critical, creative and innovative). (College-wide core competency)
	+ Describe the elastomer strain gauge
	+ Identify advantage of the elastomer compared with foil strain gauges
	+ Identify challenges to getting the new technology into common use.
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| Understandings*Students will understand that:** A Wheatstone Bridge is a series-parallel resistor circuit, and can be analyzed using the tools they’ve learned for circuit analysis.
* The Wheatstone Bridge has important applications, including use in stain gauges for structural monitoring.
* Researchers continue to look for better ways to apply electronics principals in applications.
* The skills they’re learning in this class have interesting and important application in the “real” world.
 | Essential Questions* How do you “redraw” the Wheatstone Bridge circuit to more easily recognize the series-parallel relationship among the resistors?
* What’s the best way to assemble the circuit for use and measurement?
* How is the Wheatstone Bridge used with a strain gauge?
* How is a typical strain gauge applied to structures?
* How does the elastomer strain gauge work?
* How can you apply the elastomer strain gauge to a structure?
* What tests and evaluations would you need to do to show that the elastomer strain gauge is accurate and reliable?
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| *Students will know:** Key terms: Wheatstone Bridge, strain gauge
* Elastomer strain gauges are variable resistors
 | *Students will be able to:** Build, analyze, and take measurements in Wheatstone Bridge circuits
* Describe some of the steps needed to commercialize and apply new technologies in electronics
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| Stage 2 – Assessment Evidence |
| Performance Tasks* Wheatstone Bridge Circuit: Student will be given a circuit drawing of a Wheatstone Bridge. They will calculate expected values of resistance, voltage and current at point specified on the circuit drawing Then they will build the circuit on a breadboard and take measurements to confirm their calculations.
* New technology report and discussion: In groups of 2-4, students will do research and make a short presentation about an aspect of the elastomer strain gauges.
 | Other Evidence* Weekly quiz
* Unit exam
* In-class discussion
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| Stage 3 – Learning Plan |
| 1. Show video of strain gauges: <http://www.youtube.com/watch?v=PKyTOj8C9do> H
2. Introduce the Essential Questions and describe the activities that will be done. W
3. Present material that describes the Wheatsone Bridge circuit. E
4. Ask students to try to describe the series-parallel relationship based on what they already know about series-parallel circuits. E
5. Depending on how students do in step 4, show the redrawn circuit and walk through the analysis that shows 2 parallel branches, each with 2 resistors in series. E, R
6. Draw another Wheatstone Bridge example and ask students to evaluate it. Have them compare their answers in groups of 2. R, E-2
7. Discuss the application of the Wheatstone Bridge with the strain gauges from step 1. E
8. Show students the sample elastomer strain gauges and explain the principle of operation. E
9. Ask students to think about how the elastomer strain gauges could be used. R
10. Break students into groups of 2 – 4 students. Assign each group a question to be researched and reported on for the next week. The questions are: What advantages does the elastomer have compared with the foil strain gauge? What tests do you think need to be done to “prove” the elastomer strain gauge? What things would have to be worked out before the elastomer strain gauge would be a useful commercial product? R
11. In lab, present students with a circuit drawing. Have the student analyze the circuit drawing, then build the circuit. E, R, T
12. Observe the students making measurements within the circuit. Provide feedback and allow them to correct mistakes. R, E-2.
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