

GUIDED PRACTICE

Class: ECE 3201

Date assigned: September 4, 2018

Date Due: September 6, 2018

Time estimate to complete this assignment: 2 hours

Overview /Introduction

Students have most likely have never designed a temperature controlled system using a thermistor. This lesson will introduce the students to the theory of thermistors, their mathematical models, and their physical characteristics. The students will be responsible for using these tools to design a temperature controlled system using a thermistor.

Learning Objectives

Basic objectives

1. Students will know the overall behavior of a thermistor. Students should be able to draw a graph of a thermistor response.
2. Student will know the physical characteristics of a thermistor.
3. Students will know the basic equations that predict the behavior of a thermistor.

Advanced objectives

Students are encouraged to use Matlab or other mathematical programs to assist them in solving the problems. PSpice should be used to verify that a design functions properly.

1. Students will be able to determine the slope of a thermistor curve at a given temperature.
2. Students will be able to calculate the resistance of a thermistor at a given temperature.
3. Students will be able to calculate the value of beta at different temperatures.
4. Students be able to calculate the percent error in the resistance of a thermistor given the variability of beta.

Preparatory Activities and Resources

1. Students should read chapter 14 in their textbook.
2. Students should attempt the homework problems on Blackboard.
3. Browse YouTube for videos related to thermistors and temperature controlled systems.

Exercises: Please complete by September 6, 2018

1. Students should submit their homework solutions on blackboard. Answers but not solutions to the problems are shown on Blackboard. Students should submit their homework solutions before the class meeting.

Questions?

If you have any questions see me during my office hours or e-mail me.

LESSON PLAN

Lesson: Introduction to thermistor temperature sensors

Timeframe: The students should take two hours to complete the following tasks:

1. Watch a preclass video on thermistors and read Vishay Application Notes.
 - a. *Thermistor for measuring/controlling temperature--*
<https://www.youtube.com/watch?v=9opuvLXAetI> 4.5 min
 - b. *How to wire it! Thermistors*
<https://www.youtube.com/watch?v=jmva62r8KUU> 7:14 min
 - c. Vishay BCCOMPONENTS webpage
<http://www.vishay.com/docs/29053/ntcapnote.pdf>
 - d. Read thermistor data table on blackboard
 - e. Work homework problems on blackboard.

Materials needed: Overhead projector, VOM meter, thermistor, thermometer, wire and connectors, and heat gun

Objectives:

Basic:

1. Students will learn how to read a manufacture's thermistor data sheet.
2. Students will learn how to heat and measure resistance of a thermistor.
3. Students will learn the temperature limitations of a thermistor.

Advanced:

1. Students will learn how to use a thermistor and operational amplifier as a switch.
2. Students will learn how to design a trip set point for a temperature application using a voltage divider circuit.

Background to the Lesson

Students will have to draw upon the theory of operation amplifiers which is a prerequisite for the class and upon the theory of voltage dividers which is also a prerequisite for the class.

This class emphasizes the use and application for electrical circuit theory which they had in previous classes but that they never learned to apply in a practical application.

Introduction to Lesson

This lesson will be a presentation of the theoretical (mathematically based) background of thermistors which are nonlinear temperature sensors. There are four (4) tables below that show the preclass, in class (individual) in class (group) and post-class activities for a lesson on thermistors which are temperature sensors that show an exponential decrease in resistance with increasing temperature. Students will learn both first order and second order equations that can be used in the design of a temperature controlled circuit. They will also learn the limitations of both equations.

Ask students to work in groups to develop and design a simple temperature based control system which will control a light, cooling system, or alarm system.

Students will have actual thermistor sensors, multimeters, and heat sources at their disposal.

There are numerous videos available on YouTube that show how to build a typical temperature controller.

Procedure [Time needed, include additional steps if needed].

Preclass activities, see Table 1. These activities are to be performed by the student before arriving at the class. A quiz will be given at the beginning of the class to measure what the students learned in the preclass activity. These will be graded by other class members and turned in to the instructor. A grading guide will be included on the quiz.

Table 1. Preclass Activities

Steps	Purpose	Estimated Time	Learning Objective
Step 1 Watch a video on thermistor application	Students will learn what a thermistor looks like and know how it is incorporated into a temperature control system.	One hour	Students will know what a thermistor looks like and know how they are used to build a temperature controlled system.
Step 2. Read theoretical background of thermistor equations	Understand basis of a theoretical design.	½ hour	Students will learn the theoretical basis of a thermistor and how to apply its equations to develop a working temperature control system

			based on basic circuit theory of previous course materials.

Table 2. In-Class Individual Space Activities and Resources.

Steps	Purpose	Estimated Time	Learning Objectives
Step 1. Students will take quiz	Determine if students are performing out of class assignments	10 min	Show students that completing preclass activities are important to understanding the in-class activity
Step 2. Students will grade another student's quiz. Ask students to exchange their quiz with another student	Show students how another student answer a quiz	10 min	

Table 3. In-Class Group Space Activities and Resources.

Steps	Purpose	Estimated Time	Learning Objectives
Step 1. Ask students to form a group.	Group will design a temperature controlled system based on a thermistor	1 hour	Students learn will how to work as group to design a system. Students will learn how group dynamics affect the end result design.

Table 4. Post-Class Individual Space Activities and Resources.

Steps	Purpose	Estimated Time	Learning Objectives
Step 1.	Student comprehends how to solve different	1 hr	Students will be able to solve different types of temperature control problems

Assign homework problems from Blackboard	kinds of temperature control systems		