EET-1150: BASIC ROBOTICS WITH MATH

Cuyahoga Community College

Viewing: EET-1150 : Basic Robotics with Math

Board of Trustees:
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Academic Term:
Fall 2019

Subject Code
EET - Electrical/Electronic Engineer

Course Number:
1150

Title:
Basic Robotics with Math

Catalog Description:
The course provides an introduction to embedded control principals using C programming with an emphasis on mathematics.

Credit Hour(s):
2

Lecture Hour(s):
1

Lab Hour(s):
2

Requisites

Prerequisite and Corequisite
None.

Outcomes

Course Outcome(s):
Write a program that uses sensors for input or output to accomplish a given task.

Essential Learning Outcome Mapping:
Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):
1. Explain the relationship between hexadecimal and ASCII (American Standard Code for Information Interchange).
2. Write the code that resets and displays information on an LCD (Liquid Crystal display).
3. Analyze and explain the concept of Lidar (Light Detection and Ranging) and, if the training platform provides.
4. Write code to use the output of a Lidar sensor to accomplish some task.
5. Explain the operation of a servo motor and find the degrees of rotation per step (pulse) and the number of steps to produce 1 revolution of the serve motor shaft.
6. Explain the concept underlying the purpose and use of a gyro sensor and, if the training platform provides.
7. Write code to use the output of a gyro sensor to accomplish some task.
8. Explain the concept underlying the purpose and use of a camera and, if the training platform provides.
9. Write code to use the output of a gyro sensor to accomplish some task.
10. Explain the concept underlying the purpose and use of a GPS (Global Positioning System) sensor and, if the training platform provides.
11. Write code to use the output of a gyro sensor to accomplish some task.

Course Outcome(s):

Demonstrate by calculation and measurement the use of electronic laws.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Given the current and resistance, calculate (measure) voltage
2. Given the voltage and resistance, calculate (measure) voltage.
3. Given the voltage and current, calculate (measure) the resistance.
4. Given the current and resistance, calculate the power.
5. Given the current and voltage, calculate the power.
6. Given the voltage and resistance, calculate the power.
7. Explain the relationship between energy and power.

Course Outcome(s):

Use the underlying math and electronic concepts to demonstrate and explain power and distribution.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Using a DMM (Digital Multimeter) measure the voltage of a power supply that can include a cell or battery.
2. Explain what "ground" means and identify the ground symbol on a schematic diagram.
3. Explain power distribution from a power source (like a cell or battery) and, given a current value, select the correct wire size using the AWG (American Wire Gauge) table.
4. Study and explain the dangers associate with lithium batteries regarding puncture and overcharging.

Course Outcome(s):

Apply right angle trigonometry to calculate optimum routes (vectors) to move a training platform from one point to another.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Use the sine function to assist in route calculations.
2. Use the inverse sine function to determine angles for route calculations.
3. Use the cosine function to assist in route calculations.
4. Use the inverse cosine function to determine angles for route calculations.
5. Use the tangent function to assist in route calculations.
6. Use the inverse cosine function to determine angles for route calculations.

Course Outcome(s):

Demonstrate by calculation the necessity of the use of quadratic equations when determining the relationship between power, voltage and current.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Given the resistance, graph power versus voltage using the P = V^2/R law.
2. Given the resistance, graph power versus current using the P = I^2 * R law.

3. Given the resistance and power, find the voltage.
4. Given the resistance and power, find the current.
5. Using the quadratic formula, find the roots of a function that has two real roots.
6. Graph a function that has two real roots.
7. Using the quadratic formula, find the roots of a function that has one real root.
8. Graph a function that has one real root.
9. Using the quadratic formula, find the roots of a function that has two imaginary roots.
10. Graph a function that has two imaginary roots.

Course Outcome(s):

Explain the concept of Proportional, Integral and Differential (PID) control system

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Explain and give example(s) of proportion control as it relates to a PID controller
2. Explain and give example(s) of Integral control as it relates to a PID controller
3. Explain and give example(s) of differential control as it relates to a PID controller

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Course Outcome(s):

Demonstrate by programming and/or testing and/or explaining the components of a micro controller (uC) that may include but are not limited to:

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Demonstrate the display a program variable using print statements or the Independent Development Environment (IDE) tools.
2. Explain or write a program that uses Inter Integrated Circuit (I2C) communications protocol.
3. Explain or write a program that uses Serial Peripheral Interconnect (SPI) communications protocol.
4. Explain the types of memory used in a uC.
5. Explain the pros and cons of polling versus interrupts.
6. Explain or write a program using pointers/references.

Methods of Evaluation:

1. Lab assignments with teacher sign off sections
2. Homework question (part of lab)
3. Tests
4. Class participation

Course Content Outline:

1. Program robot or other training platform to perform maneuvers using the C programming language
    a. Using while loop control
    b. Using for loop control
    c. Using conditional statements
    d. Using sensors
2. Show good programming form
    a. Indent code properly (as shown on program printout)
    b. Comment code properly (as shown on program printout)
3. Work in teams
    a. Communication
    b. Respect
    c. Appropriate language

   d. Listening
   e. Cooperation
4. Underlying math concepts
   a. Solving for variables
   b. Graphing
   c. Interpreting a graph
   d. Measuring
   e. Using equations
   f. Definition of slope
   g. Equation of a line
   h. Second degree equations
   i. Sine function
   j. Cosine function
   k. Tangent function
   l. Word problems
   m. Quadratic equations
5. Apply math to programming
6. Use electronic formulas to solve problems
   a. Ohms law
   b. Power equations
7. Use physics to solve robotic related problems
   a. Motor torque
   b. Wheel and gear sizing
   c. Force-distance equations
   d. Mass and kinetic energy.
8. Control systems
   a. Proportional control
   b. Integral control
   c. Differential control
   d. PID control
9. Sensors
   a. Ultrasonic
   b. Switch
   c. Infrared
   d. Lidar
   e. LCD
   f. gyro
   g. servo
   h. GPS

Resources

YTA Instructors/staff. *EET-1150 Lab Manual*. Updated as needed. Cleveland OH: Cuyahoga Community College, 2019.

YTA instructors/staff. *YTA Project Text, EET-1150*. Updated as needed. Cleveland OH: Cuyahoga Community College, 2019.

YTA faculty/staff. *EET-1150 Workbook*. Cleveland Oh: Cuyahoga Community College, 2019. Updated as needed.

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