

## COURSE OUTLINE

### **Engineering 130 Introduction to Robotics**

#### **I. Catalog Statement**

Engineering 130 provides an introductory study of the fundamentals of mobile robotics and the associated engineering concepts. It prepares students for more advanced studies in robotics and related technologies. Students gain experience with fundamental concepts in robot design, computer aided design and drafting, sensors and actuators, programming, and electronics. The vast majority of the course experience consists of implementation of and experimentation with these skills through hands-on labs.

Total Lecture Units: 1.0

Total Laboratory Units: 1.0

**Total Course Units: 2.0**

Total Lecture Hours: 16.0

Total Laboratory Hours: 48.0

**Total Faculty Contact Hours: 64**

Prerequisite: None.

#### **II. Course Entry Expectations**

Skill Level Ranges: Reading 5; Writing 4; Listening/Speaking 5; Math 4.

#### **III. Course Exit Standards**

Upon successful completion of the required coursework, the student will be able to:

1. demonstrate skills in the essentials of mobile robot technology;
2. program and operate various types of robots;
3. demonstrate skills of fundamental concepts in robot design;
4. demonstrate basic skills in computer aided drafting and design;
5. demonstrate basic knowledge of electronic circuits.

**IV. Course Content**

**Total Faculty Contact Hours = 64**

A. Introduction to Robotics and the VEX hardware system	Lecture 1 hours
1. Robotics application	Lab 2 hours
2. Introduction to sensors, actuators, and controls	
B. Fundamental Mechanical Aspects of Robotics	Lecture 4 hours
1. Speed, power, torque, and DC motors	Lab 10 hours
2. Gears, gear ratios, and compound gearing	
3. Friction and traction	
C. Mechanical Design	Lecture 4 hours
1. Drivetrain design	Lab 12 hours
2. Mechanical design challenge	
3. Introduction to Autodesk Inventor 3D CAD modeling software	
D. Programming	Lecture 4 hours
1. RobotC language structure and syntax	Lab 12 hours
2. Motion programming and wait commands	
3. Reading sensors (touch sensors, encoders, ultrasonic sensors)	
4. Program structures - loops, if-then, switch-case	
E. Breadboard-Based Robot Assembly	Lecture 3 hours
1. Programming in PICAXE BASIC	Lab 12 hours
2. Basic principles of electronic circuits	

**V. Methods of Instruction**

The following instructional methodologies may be used in the course:

1. lecture and demonstration;
2. instructor and peer analysis of student work;
3. individual instructor-to-student assistance in the class.

## **VI. Out of Class Assignments**

The following out of class assignments may be used in the course:

1. group project (e.g. work on a robot design, possibly in 3D CAD software if available, to be implemented during class);
2. individual project (e.g. work on a robot design, possibly in 3D CAD software if available, to be implemented during class);
3. calculations (e.g. carrying-out calculations related to a robot design, such as torque or gear ratios).

## **VII. Methods of Evaluation**

The following methods of evaluation may be used in the course:

1. midterm examinations and quizzes;
2. performance-based assessment of student designed/built robots;
3. instructor evaluation of student portfolio work;
4. final examination.

## **VIII. Textbook**

Autodesk's VEX Robotics Curriculum materials (provided to students free of charge)

Siegwart, Roland, Nourbakhsh, Illah, and Scaramuzza, Davide. *Introduction to Autonomous Mobile Robots*. Second Edition. Cambridge, MA: MIT Press, 2011. 13<sup>th</sup> Grade Textbook Reading Level. ISBN-13: 978-0-262-01535-6.

## **IX. Student Learning Outcomes**

1. Students will design and implement robot designs to overcome physical challenges.
2. Students will compose software that will control a mobile robot to complete tasks successfully, including the integration of sensing, sensor-data processing, and robot action.
3. Students will demonstrate basic working knowledge of a 3D CAD software system.
4. Students will utilize basic principles of mechanics to design robots.