

## Robotics I Semester A

### Course Overview

Robotics I, Semester A is a one-semester course that explains various concepts related to robotics. This course begins by describing the evolution and applications of robotics. This course helps you identify career opportunities and important employability skills in robotics. You will explain the importance of teamwork and describe the skills needed to work in a team. You will describe Newton's laws of motion and their applications in robotics. You will describe basic concepts of electricity, electronic circuits, Boolean algebra, magnetics, and their applicability to robotics. You will apply safety procedures and construct a simple robot.

### Course Goals

By the end of this course, you will:

- Describe the evolution and applications of robotics.
- Identify career options in the field of robotics.
- Explain the importance of teamwork in the field of robotics.
- Describe Newton's laws of motion and their applicability to robotics.
- Explain the basic concepts of electricity and their application in robotics.
- Describe Boolean logic and construct truth tables.
- Describe the use of sensors in robotics.
- Describe the use of motors and gears in the movement of robots.
- Describe and apply safety procedures and practices when working with robots.
- Construct a simple robot.

### General Skills

To participate in this course, you should be able to do the following:

- Complete basic operations with word-processing software such as Microsoft Word and presentation software such as Microsoft PowerPoint.
- Perform online research using various search engines and library databases.
- Communicate through email and discussion boards.

*For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Student Orientation document, found at the beginning of this course.*

## **Credit Value**

Robotics I, Semester A is a 0.5-credit course.

## **Course Materials**

- notebook
- computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Microsoft PowerPoint or equivalent
- Scanner
- Camera
- materials listed in Appendix B (Appendix C provides a detailed breakdown of these materials by activity.)

Note: Your course teacher will provide directions on necessary materials, based on the teacher's specific activity plans and recommendations provided in the Robotics Teacher's Guide.

## **Course Pacing Guide**

This course description and pacing guide is intended to help you stay on schedule with your work. Note that your course teacher may modify the schedule to meet the specific needs of your class.

## Course Components and Grading Rubric

The table gives a breakdown of the weight for each component in the course. Weight represents the percentage of the total score coming from each activity.

| Course Components  | Count     | Weight      |
|--|-----------|-------------|
| <b>Pretest.</b> <i>Pretests are optional assessments, typically designed for credit recovery use. If a student shows mastery of a lesson's objective, the student may be automatically exempted from that lesson in the upcoming unit. Typically, teachers do not choose to employ exemptive pretests for first-time credit courses. Pretests are not included as a component of the student's final grade.</i>  | 4         | 0%          |
| <b>Module.</b> <i>Each module in this course contains an interactive tutorial and an associated mastery test. Tutorials may include one or more Lesson Activities that constitute tasks associated with the tutorial. The module score comes from a student's score on the mastery test.</i>   | 16        | 20%         |
| <b>Discussion.</b> <i>Online discussions allow for higher-order thinking about terminal objectives. An online threaded discussion mirrors the educational experience of a classroom discussion. Teachers can initiate a discussion by asking a complex, open-ended question. Students can engage in the discussion by responding both to the question and to the thoughts of others. Each unit in a course has one predefined discussion topic; teachers may add more discussion topics.</i> | 4         | 20%         |
| <b>Unit Activity.</b> <i>Unit Activities are at the end a unit and constitute one or more small tasks. Their purpose is to deepen understanding of key unit concepts and tie them together. Each Unit Activity includes a simple rubric. The teacher versions include both a rubric and modeled sample answers. Unit Activities are teacher graded.</i>  | 4         | 20%         |
| <b>Posttest.</b> <i>The posttest appears at the end of the unit and mirrors the pretest in structure, content, and complexity.</i>   | 4         | 20%         |
| <b>End of Semester Test.</b> <i>The end of semester test (EOS) appears at the end of the course. Students are delivered a few items from every tutorial in the course in order to assess the major course objectives.</i>  | 1         | 20%         |
| <b>Total</b>   | <b>33</b> | <b>100%</b> |

\*Teachers may manually adjust these weights if desired, per district grading requirements.

# Unit 1: History and Careers

## Summary

In this unit, you will describe the key milestones in the evolution of robotics and the future of robotics. You will identify courses, certifications, and job roles available in the field of robotics. Additionally, you will describe appropriate workplace etiquette and develop workplace performance goals. Finally, you will explain the characteristics of an effective team and identify leadership qualities required to build strong relationships among team members.

| Day              | Activity/Objective  | Type                         |
|------------------|---|------------------------------|
| 1 day:<br>1      | <b>Syllabus and Student Orientation</b><br><i>Review the Student Orientation and Course Syllabus at the beginning of this course.</i>                         | Course Orientation           |
| 4 days:<br>2–5   | <b>Introduction to Robotics</b><br><i>Describe the evolution and applications of robotics.</i>  | Lesson                       |
| 4 days:<br>6–9   | <b>Careers in Robotics</b><br><i>Identify career options in the field of robotics and educational qualifications required to enter the field of robotics.</i> | Lesson                       |
| 4 days:<br>10–13 | <b>Employability Skills</b><br><i>Describe the skills required for a career in robotics.</i>  | Lesson                       |
| 4 days:<br>14–17 | <b>Teamwork</b><br><i>Explain the importance of teamwork in the field of robotics.</i>  | Lesson                       |
| 1 day:<br>18     | <b>Para Jumble</b>  | Game                         |
| 5 days:<br>19–23 | <b>Unit Activity and Discussion—Unit 1</b>  | Unit Activity/<br>Discussion |
| 1 day:<br>24     | <b>Posttest—Unit 1</b>  | Assessment                   |

# Unit 2: Foundations of Robotics

## Summary

In this unit, you will describe the role and utility of six simple machines in robot creation. You will compare different forms of energy and also describe Newton’s three laws of motion. You will explain the basic concepts of electricity and their applications in robotics. Additionally, you will build a basic circuit on a breadboard and describe common electronic components. You will also explain the basic laws of Boolean algebra and construct truth tables and logical expressions. Finally, you will describe how

magnetic fields are used for good controllability of robots and the use of magnetically actuated micro-robots in the healthcare industry.

| <b>Day</b>       | <b>Activity/Objective</b>  | <b>Type</b>                  |
|------------------|--|------------------------------|
| 4 days:<br>25–28 | <b>Six Simple Machines</b><br><i>Describe six simple machines and their applicability to robotics.</i>                         | Lesson                       |
| 4 days:<br>29–32 | <b>Newton’s Laws of Motion</b><br><i>Describe Newton’s laws of motion and their applicability to robotics.</i>                 | Lesson                       |
| 4 days:<br>33–36 | <b>Electricity</b><br><i>Explain the basic concepts of electricity and their application in robotics.</i>                      | Lesson                       |
| 4 days:<br>37–40 | <b>Electronic Circuits</b><br><i>Describe the operation of common electronic components and build a circuit on breadboard.</i> | Lesson                       |
| 4 days:<br>41–44 | <b>Boolean Algebra</b><br><i>Describe Boolean logic and construct truth tables.</i>  | Lesson                       |
| 3 days:<br>45–47 | <b>Magnetics</b><br><i>Describe magnetics and its applicability to robotics.</i>   | Lesson                       |
| 1 day:<br>48     | <b>Space Jumble</b>  | Game                         |
| 5 days:<br>49–53 | <b>Unit Activity and Discussion—Unit 2</b>   | Unit Activity/<br>Discussion |
| 1 day:<br>54     | <b>Posttest—Unit 2</b>   | Assessment                   |

## Unit 3: Robotics Sensors and Motors

### Summary

In this unit, you will describe different types of sensors and distinguish between active and passive sensors. You will also describe the use of gears in robotics and explain how a DC motor works. Finally, you will describe the purpose and use of servos in robotics and explain how angle and torque are controlled in a servo motor.

| <b>Day</b>       | <b>Activity/Objective</b>   | <b>Type</b> |
|------------------|---|-------------|
| 3 days:<br>55–57 | <b>Robotic Sensors</b><br><i>Describe the use of sensors in robotics.</i> | Lesson      |

| <b>Day</b>       | <b>Activity/Objective</b>  | <b>Type</b>                  |
|------------------|--|------------------------------|
| 3 days:<br>58–60 | <b>DC Motors</b><br><i>Describe the use of motors and gears in the movement of robots.</i> | Lesson                       |
| 4 days:<br>61–64 | <b>Servo Motors</b><br><i>Describe the use of servos in the movement of robots.</i>        | Lesson                       |
| 1 day:<br>65     | <b>Para Jumble</b>   | Game                         |
| 3 days:<br>66–68 | <b>Unit Activity and Discussion—Unit 3</b>   | Unit Activity/<br>Discussion |
| 1 day:<br>69     | <b>Posttest—Unit 3</b>   | Assessment                   |

## Unit 4: Constructing a Robot

### Summary

In this unit, you will apply safety guidelines based on the manuals and instruction guides. You will identify governmental and organizational regulations for health and safety at the workplace. You will also list and describe various tools needed in the construction of robots. Finally, you will plan, design, and construct a robot.

| <b>Day</b>       | <b>Activity/Objective</b>   | <b>Type</b>                  |
|------------------|---|------------------------------|
| 4 days:<br>70–73 | <b>Safety</b><br><i>Describe and apply safety procedures and practices when working with robots.</i>  | Lesson                       |
| 4 days:<br>74–77 | <b>Tools and Components</b><br><i>Describe various tools and components required to build robots.</i> | Lesson                       |
| 4 days:<br>78–81 | <b>Build a Robot</b><br><i>Construct a simple robot.</i>  | Lesson                       |
| 1 day:<br>82     | <b>Thwack-A-Mole</b>  | Game                         |
| 5 days:<br>83–87 | <b>Unit Activity and Discussion—Unit 4</b>  | Unit Activity/<br>Discussion |
| 1 day:<br>88     | <b>Posttest—Unit 4</b>  | Assessment                   |
| 1 day:<br>89     | <b>Semester Review</b>  |                              |

| Day          | Activity/Objective          | Type       |
|--------------|-----------------------------|------------|
| 1 day:<br>90 | <b>End-of-Semester Test</b> | Assessment |

## Course Map

You will achieve course level objectives by completing each lesson’s instruction, assignments, and assessments. For a detailed look at how the materials meet these objectives, review the [course map for Semester A](#).

## Appendix A: Safety Notes and Disclaimer

Lesson Activities and Unit Activities that includes a robotics lab component highlight key safety guidelines using the safety icon (⚠️), which appears directly in the activity. In addition to adhering to those guidelines, you must ensure that you follow these general safety practices:

- Work slowly and safely at all times, and abide by the safety notes and icons.
- Pay attention and be alert at all times. Limit any distractions.
- If you don't understand something, ask a teacher or an adult before proceeding.
- Follow the procedures.
- Follow good housekeeping practices. Keep your work area clean.
- Report any problems or complications to an adult.

**NOTE:** *Edmentum assumes no liability for personal injury, property damage, equipment damage, or financial loss resulting from the instruction included in this course.*

## Appendix B: Course Lab Materials (Semesters A and B)

| Required Household Materials  |
|---|
| <ul style="list-style-type: none"><li>• cardboard</li><li>• paper</li><li>• half-liter plastic bottle</li><li>• masking tape</li><li>• sharpie</li><li>• paper clips</li><li>• drawing pins</li><li>• tennis ball</li><li>• tape</li><li>• knife</li><li>• string</li><li>• scissors</li><li>• glue gun</li><li>• marker</li><li>• drinking straws</li><li>• elastic bands</li><li>• plastic sheets</li><li>• presentation software</li><li>• word processing software</li><li>• spreadsheet software</li></ul> |



### **Additional Required Materials**

The italicized materials below are available in the suggested “minimum equipment” kit identified in the Robotics Course Teacher Guide.

- steel rod (about 5 to 6 inch in length and 1/4 inch in diameter)
- 1.5V DC bulb
- 1.5V DC bulb holder
- 2 insulated wires (20 inch length)
- 1.5 V DC switch
- multimeter
- resistors (1 $\Omega$ , 10 $\Omega$ , 1K $\Omega$ , 10K $\Omega$ , 2 220  $\Omega$ )
- breadboard
- breadboard wires
- 2 battery clips
- 2 LEDs
- 200 grams iron fillings
- small funnel
- plastic test tube
- cylindrical magnet that fits into the plastic test tube
- NE555 IC
- 100 $\mu$ F capacitor
- 9V battery
- wire stripper
- gears of varying sizes, 2 cm to 12 cm diameter
- 4 1.5V AA batteries

Minimum contents for major projects (Available in suggested kit identified in the Teacher Guide.)

- *chassis*
- *wheels*
- *2 6P6C RJ25 cables*
- *4 brass stud M4\*25*
- *battery holder*
- *2 motors*
- *Velcro*
- *USB cable*
- *8 M3 nuts*
- *Arduino Uno microcontroller*
- *light sensor*
- *battery shell*
- *mini caster wheel*
- *screw driver*
- *screws*
- *ultrasonic sensor*

## Appendix C: Lab Materials by Activity (Semester A)

The italicized materials below are available in the suggested “minimum equipment” kit identified in the Robotics Course Teacher Guide.

| Unit | Lesson/Unit Activity Name          | Task   | Equipment List  |
|------|------------------------------------|--|---|
| 1    | Unit Activity: History and Careers | Task: Careers and Skills                               | presentation software   |
| 2    | Lesson 2.1: Six Simple Machines    | Lesson Activity: Simple and Compound Machines (Part C) | <ul style="list-style-type: none"> <li>• cardboard</li> <li>• string</li> <li>• rod</li> </ul>  |
| 2    | Lesson 2.3: Electricity            | Lesson Activity: Building a Simple Circuit             | <ul style="list-style-type: none"> <li>• 1.5V DC bulb</li> <li>• 1.5V DC bulb holder</li> <li>• 2 insulated wires</li> <li>• 1.5 V DC switch</li> <li>• batteries</li> <li>• <i>battery holder</i></li> </ul>   |
|      |                                    | Lesson Activity: Ohm's Law                             | <ul style="list-style-type: none"> <li>• 2 insulated wires</li> <li>• multimeter</li> <li>• resistors (1<math>\Omega</math>, 10<math>\Omega</math>)</li> <li>• DC switch</li> <li>• batteries</li> </ul>  |
| 2    | Lesson 2.4: Electronic Circuits    | Lesson Activity: Breadboard Creation                   | <ul style="list-style-type: none"> <li>• breadboard</li> <li>• breadboard wires</li> <li>• 9V battery</li> <li>• battery clip</li> <li>• 1 LED</li> <li>• 1k<math>\Omega</math> resistor</li> </ul>   |
| 2    | Lesson 2.6: Magnetism              | Lesson Activity: Magnetic Lines of Force               | <ul style="list-style-type: none"> <li>• half-liter plastic bottle</li> <li>• iron filings</li> <li>• plastic test tube whose length is almost equal to the bottle and that easily fits into the bottle's mouth</li> <li>• masking tape</li> <li>• funnel</li> <li>• cylindrical magnet that fits into the plastic test tube</li> </ul> |

| Unit | Lesson/Unit Activity Name                 | Task                              | Equipment List   |
|------|---|-----------------------------------|--|
| 2    | Unit Activity:<br>Foundations of Robotics | Task 1: Newton's Laws             | <ul style="list-style-type: none"> <li>• sharpie</li> <li>• paper</li> <li>• drawing pins</li> <li>• tennis ball</li> </ul>  |
|      |   | Task 2: Breadboarding a Circuit   | <ul style="list-style-type: none"> <li>• NE555 IC</li> <li>• 100<math>\mu</math>F capacitor</li> <li>• LEDs (2) (any color)</li> <li>• 220<math>\Omega</math> resistors (2)</li> <li>• 1K<math>\Omega</math> resistor</li> <li>• 10K<math>\Omega</math> resistor</li> <li>• 9V battery</li> <li>• wires</li> <li>• breadboard</li> </ul> |
| 3    | Lesson 3.2: DC Motors                     | Lesson Activity: Building a Motor | <ul style="list-style-type: none"> <li>• insulated wire</li> <li>• tape</li> <li>• marker</li> <li>• paper clips</li> <li>• magnet</li> <li>• battery</li> </ul>   |
| 4    | Lesson 4.3: Build a Robot                 | Lesson Activity: Building a Robot | (No materials needed)  |

| Unit | Lesson/Unit Activity Name              | Task                       | Equipment List   |
|------|--|----------------------------|--|
| 4    | Unit Activity:<br>Constructing a Robot | Task: Constructing a Robot | <ul style="list-style-type: none"> <li>• 4 1.5V AA batteries</li> <li>• <i>chassis</i></li> <li>• <i>wheels</i></li> <li>• 2 6P6C RJ25 cables</li> <li>• 4 brass stud M4*25</li> <li>• <i>battery holder</i></li> <li>• 2 <i>motors</i></li> <li>• <i>Velcro</i></li> <li>• <i>USB cable</i></li> <li>• 8 M3 <i>nuts</i></li> <li>• <i>Arduino Uno microcontroller</i></li> <li>• <i>light sensor</i></li> <li>• <i>battery shell</i></li> <li>• <i>mini caster wheel</i></li> <li>• <i>screw driver</i></li> <li>• <i>screws</i></li> <li>• <i>ultrasonic sensor</i></li> </ul> |