

**Robotics and Automation  
Central High School  
2023-2024**

**INSTRUCTOR:** Johnathan Michael  
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**GRADES:** 9<sup>th</sup>-12<sup>th</sup>

**PREREQUISITES:** Algebra I (3102); Geometry (3108); Physical Science (3202); and Chemistry (3221) or Physics (3231)

**COURSE DESCRIPTION:**

Robotics & Automated Systems is an applied course for students who wish to explore how robots and automated systems are used in industry. Upon completion of this course, proficient students will have an understanding of the historical and current uses of robots and automated systems; programmable circuits, interfacing both inputs and outputs; ethical standards for engineering and technology professions; and testing and maintenance of robots and automated systems. Note: Standards in this course are presented sequentially for students' learning progression; however, instructors may tailor the order of course standards to their specifications. Students are expected to use engineering notebooks to document procedures, design ideas, and other notes for all projects throughout the course..

**LEARNING MANAGEMENT SYSTEMS:**

VEX Robotics

**GRADE SCALE:**

A numerical average will be derived over the semester by dividing total points possible into total points earned by the student. Letter grades will be assigned based on final numerical averages in accordance with county policy. Please note that students will not receive a numerical grade over 100, because this is not an advanced placement course.

**EVALUATION:**

The final grade for the course will be based on the following items:

1. Participation/Activities	50%
2. Tests/Skills	35%
3. Final Exam	15%
<b>TOTAL</b>	<b>100 %</b>

**COURSE STANDARDS:**

**Safety**

1) Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply.

2) Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. **Robotics Overview**

3) Research the historical use of robotics from textbooks, news media, and other informational texts. Create a presentation concerning the various uses of robotics. For example, explore areas such as the surgical field, space exploration, agriculture, and advanced manufacturing.

4) Write a persuasive essay explaining why robots should be used in certain circumstances. Cite textual evidence to support claims (for example, assemble evidence from medical journals to support a claim that the use of robots has lowered costs and increased efficiency among medical providers). Other examples may derive from the areas identified in standard 3. During a class discussion, defend original arguments and debate peer perspectives using claim(s) and counterclaim(s) developed in the persuasive essay.

## **Career Exploration**

5) Create a presentation illustrating industries, organizations, and careers in Tennessee and other states that use robotics (such as Nissan in Automotive Manufacturing). Include work activities involved, postsecondary education needed, and skills necessary for these careers. (These could range from industry certifications to degrees in robotics engineering.)

6) Research the ethical considerations involved in developing new and modifying existing technologies. For example, investigate the National Society of Professional Engineers' (NSPE) Code of Ethics for Engineers or the Computer Ethics Institute's Ten Commandments of Computer Ethics. Select an existing technology and describe the ethical dilemmas faced by both producers and consumers of that technology, such as trade-offs between individual versus societal benefits or unforeseen consequences to the environment. For example, examine why some workers and labor unions may view robots as a threat to their jobs. Present findings to the class in a format appropriate for a career and technical student organization (CTSO) event.

## **Programming**

7) Create a flowchart of a program for a robotic system. Convert the flowchart into a working program. Test, modify, and optimize the program. Write a technical report evaluating the performance of the program. Support all claims with specific examples.

8) Log, store, and export data received from two or more sensors (for example, vision/light, audio, and touch) in a robotic or automated system. Explain why these procedures would be useful and provide specific examples. **Engineering Design and Science & Engineering Practices**

9) Compare and contrast the following engineering design process with the eight practices of science and engineering (Achieve, 2013). Based on observations, write a brief paper explaining how the engineering design process and the science and engineering practices overlap, and describe how they might be used in automated systems design. Present findings to the class and refine the paper based on feedback.

Engineering Design Process Science and Engineering Practices  
a) Identify the problem a) Asking questions (for science) and defining problems (for engineering)  
b) Identify criteria and specify constraints  
b) Developing and using models  
c) Brainstorm possible solutions  
c) Planning and carrying out investigations  
d) Research and generate ideas  
d) Analyzing and interpreting data  
e) Explore alternative solutions  
e) Using mathematics and computational thinking  
f) Select an approach  
f) Constructing explanations (for science) and designing solutions (for engineering)  
g) Write a design proposal  
g) Engaging in argument from evidence  
h) Develop a model or prototype  
h) Obtaining, evaluating, and communicating information  
i) Test and evaluate  
j) Refine and improve  
k) Create or make a product  
l) Communicate results

## **Computers and Electronics**

10) Create an explanatory presentation that describes the parts necessary to make a robot and distinguishes it from a computer and a non-robotic machine. Parts necessary to make a robot include: (1) having a microprocessor for a brain, (2) sensors for input and output, (3) controls, and (4) motors. The presentation should include an informative report that describes various types of sensors (for example, auditory, visual, heat, etc.) and a summary of how sensors provide input. It should also describe various types of output (for example, motors, mechanisms, speakers, light, etc.) and discuss how sensors provide output.

11) Design, develop, and test a program to control a robotic system and robotic subsystems. The program should be able to receive data from a robot's input devices, process the data, and create outputs based on the inputs received. Present the robotic system to the class and provide details on the methodology used to design and develop the program, justifying selections as appropriate.

12) Utilize feedback loops in a robotic system. For example, create a demonstration scenario and program a robot that requires the following: start, stop, or change motion within a robotic or automated system based on sensor input, provided by two or more sensors (such as vision/light, audio, and touch).

## **Mechanics**

13) Use mechanical tools, such as motors, gears, and gear trains in the construction of a robotic or automated system. Identify where forces are acting upon various points on the system and document with simple diagrams. Use the concepts of force, torque, and mechanical advantage to calculate the force acting upon the points in the system.

14) Develop a system to demonstrate force, torque, work, and power acting upon or being done by a robotic or automated system. Justify the design by creating mathematical models that show the calculations. Testing, Maintenance, Documentation, and Quality Assurance

15) Use appropriate instruments to measure and record electrical, light, and audio outputs of a robotic system. Compare measured data to acceptable norms for the system. Document whether the system is performing within accepted parameters and cite evidence to support the claims. Perform maintenance or follow recommended procedures to correct malfunctions or underperformance within the system. Write a justification for any maintenance that is performed, citing data obtained from test results.

16) Create a service and maintenance report on a robotic or automated system. The report should include text explaining the maintenance and corrective measures conducted. It should also include text justifying whether the system is functioning properly or recommending additional measures to correct any issues within the system. Finally, it should include text recommending quality-assurance policies and procedures to assure continuing operation of the system within acceptable parameters and text describing corrective Page 5 procedures to be used when the system is malfunctioning or operating below optimal performance. Projects 17) Working in a team, design and create a robotic solution to a given problem. Incorporate the engineering design process, as well as science and engineering practices, to develop a solution that meets the criteria for entries in a regional, state, or national robotics competition. Maintain an engineering notebook to document the details of the project. Write a technical paper (see components of the report below) and develop a presentation describing the solution and development process for the team solution. The technical paper should include, but is not limited to: a) Background b) Problem definition c) Design constraints d) Methodology e) Data analysis (e.g., charts, graphs, calculations) f) Results/Problem solution (include engineering drawings) g) Conclusions and recommendations for future research

**MAKE-UP WORK:** When a student has an absence:

- The student must check Schoology or Amatrol site to get work.
- It is the student's responsibility to see what needs to be made up and that this is done at the teacher's convenience.
- If the work is not completed by the extended due date assigned, the student receives a zero for the incomplete work.

#### **CLASSROOM RULES AND EXPECTATIONS:**

Every student will be expected to conduct him or herself in a manner that does not interfere with the learning process. Students that interfere with the ability of the teacher to teach and other student's ability to learn will be dealt with swiftly. All specific Technology Lab rules, and the general school rules listed in the Student/Parent Handbook, will be enforced! The following are important teacher expectations:

- Respect everyone and everything.
- Clean up after yourself!
- Be on time to class.
- Be prepared for class: Book, paper and writing instrument.
- All school rules apply.
- Complete all assignments and submit for grades by all due dates.
- NO PHONES ALLOWED

Just as you expect honesty and integrity from the instructor, I will expect the same from you!

#### **DISCIPLINE:**

All students will be given a warning about expectations/rules upon first violation. A second violation will result in a conversation witnessed by another teacher and a reminder of expectations. A third violation results in an immediate phone call to parents. Any further violations will be written up and sent to an administrator. All discipline issues will be recorded in a discipline journal that will be referred to later if violations continue.

#### **NOTE:**

The instructor reserves the right to change the requirements of the course to reflect the educational needs of the class.

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**SIGNATURES:** Both the parent/guardian and the student will need to sign below indicating that they have received, read, understand, and agree to the requirements and responsibilities of the course as described in the syllabus.

**Student Signature** \_\_\_\_\_ **Date** \_\_\_\_\_

**Parent Signature** \_\_\_\_\_ **Date** \_\_\_\_\_

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