COURSE OF STUDY – CURRICULUM GUIDE

Course: # 949 Introduction to Robotics.

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Under the Direction of: Steve Whalen

Description:

Introduction to Robotics is designed to assist students in the following areas of career exploration for technology, And related employment opportunities, application of computer programming skills with computer controlled devices. The exploration of a variety of robotic manipulator designs based on work envelopes and motions produced by actuators, turntables / conveyors / CNC mill and lathe, and model autonomous mobile robots. The introduction of robotics technology and robot project construction tasks, integration of computer controlled equipment in developing flexible manufacturing systems, identification of high tech skills needed for today's changing workplace, and to develop a team-work concept for problem solving. Student achievement of these goals will be obtained through formal discussion / note taking procedures, active participation in class discussions, computer applications, IMC and internet research assignments and presentations, completion of homework assignments, laboratory experiments, and technology learning activities. Student evaluation will be based on test and quiz scores, lab experiments, homework assignments, research papers, student presentations, notebook evaluation, and individual / team problem solving / programming activities. Model making of robots designed for specific tasks being studied. This course will incorporate cognitive, psychomotor, and affective leaning domains in each unit of study that will enhance the student's abilities to show their knowledge gained.

Jack McGee: *Interim Assistant Superintendent for Curriculum & Instruction*
Gretchen Gerber: *Director of Elementary Education*
Cleve Bryan: *Interim Director of Secondary Education*

Written: August, 2015
Revised:
BOE Approval: SEPTEMBER, 2015

DEMONSTRABLE PROFICIENCIES

COURSE TITLE: **Introduction to Robotics**

I. CLASSWORK REQUIREMENTS

A. Task requirements – reading assignments, class discussions, note-taking, lab experiments, tests, homework, and necessary materials to complete these items

B. Information requirements – successful completion of Electrical Technology I

II. ATTITUDE & BEHAVIOR

A. Requirements to include the following:

1. Respect for others and for lab equipment
2. Responsibility for all assignments and attendance
3. Positive behavior in accordance with classroom / school rules and regulations

III. COURSE OBJECTIVES/OVERVIEW

A. COURSE CONTENT

1. Introduction to robotics technology and robot project construction
2. Introduction to computer programming for robot control
3. Introduction to flexible manufacturing principles and applications

B. SKILLS

1. Robotics applications through creation of robot models
2. Use of computer control in terms of CNC machining operations
3. Individual and group problem solving activities

C. APPRECIATION OF CONCEPTS

1. Continue career exploration for technology related fields
2. Identify high tech skills needed for today's changing work place

IV. ATTENDANCE

Attendance: Refer to Board of Education Policy

V. GRADING PROCEDURES

A. Final grade for the course will be a composite of the following:
   1. Tests
   2. Homework
   3. Notebook
   4. Individual and group project work
   5. Programming solutions to robot tasks and CNC manufacturing tasks
   6. Problem solving activities / integration of robotics and CNC equipment
   7. Extra credit where applicable

B. A final average of 70 will be a passing grade for this course.

Semester 1 Grade (S1) is calculated:
(50% of Y1)
MP1=20%, MP2= 20%,
“Mid-term”(X1) exam= 10%

Semester 2 Grade (S2) is calculated:
(50% of Y1)
MP3= 20%, MP4= 20%
Final (X2) exam = 10%

Final Grade (Y1) is calculated:
S1 + S2 = Y1

MAJOR UNITS OF STUDY

Course Title: **Introduction to Robotics**

I.	Intro to Course / Lab Safety / Careers
II.	Introduction to Industrial Robotics
III.	Fundamentals of Robotics
IV.	Programming the Robot
V.	Industrial Applications
VI.	Power Supplies and Movement Systems
VII.	Sensing and End of Arm Tooling
VIII.	Control Systems and Maintenance
IX.	Mobile Robots, Construction, Programming, & Applications
X.	Robots in Future of Manufacturing

UNIT OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 1 OVERVIEW **Unit Title:** Intro to Course / Lab Safety / Careers

Unit Description and Objectives:

This unit introduces students to basic safety information necessary to prevent injury in the lab throughout the year. Students will become aware of the types of injuries that might occur and ways to prevent them. Information in this unit will also include basic introductory robotics terminology needed to communicate in a technical manor. The class will also explore various career opportunities in the field of robotics technology.

After studying this unit, the students will be able to:

- Cite important developments in the evolution of robots.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations** **Students will understand that:**	**Guiding Questions**
1. What are the behavioral requirements needed to maintain a safe environment in the lab? 2. How has the "Robotics revolution" changed the manufacturing industry? 3. What impact has the "Robotics revolution" had on our workforce in America and throughout the world?	1. Participation and certain behavior aspects are important to successfully complete the course. 2. There are four major areas of injury in the lab and there are necessary steps to prevent injury. 3. Basic introductory robotics terms are important communication skills. 4. Training and schooling are important to enter careers in the Robotics and Manufacturing Industry.	1 What four areas of injury must be addressed throughout the year for safety? 2. What are the basic terms common in the study of robotics technology? 3. What are some opportunities to use robotics technology in the workplace?

CURRICULUM UNIT 1 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 1 - Intro to Course / Lab Safety / Careers

Conceptual Lens:

Appropriate Time Allocation (# of Days): (2 weeks)

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.12.AR.B4	9.3.IT-SUP.2-3	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.ST-ET.4	
9.3.12. AR – AV.1 – 2	9.3.IT.7		

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Class Requirements A. Classroom Rules & Regulations B. Course Proficiencies C. Daily Procedures D. Fire Drill Procedures Shop Safety in Lab A. Shocks- terms of electricity B. Burns C. Mechanical Injuries	Class Requirements A. Classroom Rules & Regulations B. Course Proficiencies C. Daily Procedures D. Fire Drill Procedures Shop Safety in Lab A. Shocks- terms of electricity B. Burns C. Mechanical Injuries D. Hazardous Materials Procedures A. Equipment Operation & Procedures B. Emergency Shut-Off Procedures C. Accident Reports	1. Students know the necessary requirements of classroom behavior and participation as stated in course proficiencies to successfully complete the course. 2. Each student will know the four major areas of injury in the lab including steps to prevent injury. 3. Each student will know the basic introductory electrical terms along with units of measure. 4. All students will know the fatal value of current to the human body. Students will be aware of necessary training and schooling to enter careers in the Robotics and Manufacturing Industry. Define the following technical terms: anthropomorphic	1. Each student will list ten safety steps to follow in the lab to prevent injury. 2. All students will complete safety labs. 3. Each student will pass a classroom safety test on procedures and operational safety. 4. Each student will be able to describe at least three reasons for choosing a particular career. 5. All students will describe a career choice in the Robotics and Manufacturing Industry and list three valid reasons for this choice.	Instructional Materials **Textbook,** pages 11–22 Review Questions, page 22 Learning Extensions, page 22 **Instructor's** Handout Masters HM 1-1 What Is an Industrial Robot? HM 1-2 Robot Classifications HM 1-3 Three Generations of Industrial Robots Lesson Slides LS 1-1 Industrial Robots LS 1-2 Flexible Manufacturing Work Cell LS 1-3 Robot Applications Chapter 1 Quiz Learning takes place by:	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Unit Quiz on procedures and class rules Safety test Chapter 1 Quiz **Summative Assessment(s)** Midterm Final

D. Hazardous Materials <u>Procedures</u> A. Equipment Operation & Procedures B. Emergency Shut-Off Procedures C. Accident Reports ***Careers*** A. Technician 1. Schooling 2. Pay 3. Job Opportunities B. Engineering 1. Schooling 2. Pay 3. Job Opportunities C. Location 1. Job Marketplace 2. Relocating 3. Lifestyle	***Types of Careers involving specific information pertaining to:*** A. Technician 1. Schooling 2. Pay 3. Job Opportunities B. Engineering 1. Schooling 2. Pay 3. Job Opportunities C. Location 1. Job Marketplace 2. Relocating 3. Lifestyle	artificial intelligence automaton fixed-sequence robot flexible automation hard automation industrial robot intelligent robot manual manipulator numerically controlled (NC) robot playback robot reprogrammable robot robotics Unimate variable-sequence robot Research and investigate local opportunities that involve the fields that are covered by the robotics industry. Identify several manufacturing industries that may utilize robots in their fields. Cite important developments in the evolution of robots. List and explain the classifications of industrial robots. Define the types of automation. Discuss the role of robots in our society.	6. Students will identify a minimum of five careers in the Robotics and Manufacturing Industry. Each student will be able to describe the impact of high tech careers on lifestyles, relocation, income, etc.	Reading Listening Watching Doing Thinking Problem solving *Reading assignments *Discussion / notes of all classroom rules and regulations *Discussion of course proficiencies. *Review discussion on harmful effects of current on human body *Review methods of preventing injury in the lab *Review safety procedures for experiments, soldering project construction, and machines. *Emergency Shut-off Procedure *Fire Drill Procedure *Complete Safety labs and related homework assignments *Discussion on types of careers available in the Robotics and *Discussion on the criteria for choosing a career, such as income, job satisfaction, location, etc. *Guest speaker presentations on various career options *Student will choose a mock career, research this career area, and report back to the class.			

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 2 OVERVIEW

Course Title: Introduction to Robotics

Unit #: Introduction to Industrial Robotics **Unit Title:** Introduction to Industrial Robotics

Unit Description and Objectives:

This unit will introduce students to the history, evolution and current applications of industrial robots in today's manufacturing industries. For centuries the idea of robots has captured people's imagination. This unit discusses the origins of the robot and explores ways in which robots began to be used in industry. Students will trace the evolution of the industrial robot, become familiar with the necessary robotic terms, and understand the most common uses of robots in today's manufacturing processes. Students will also assess most common misconceptions about the use of robots and the productivity and economic impacts associated with their use

- After studying this unit, the students will be able to:
- List and explain the classifications of industrial robots.
- Define the types of automation.
- Discuss the role of robots in our society.

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. What identifies a machine as an industrial Robot that is classified as an Anthropomorphic robot? 2. How can the Industrial robot be reprogrammable (can be given new instructions to meet changed requirements and perform new tasks)? 3. How can we make the robot flexible so that it can perform a variety of operations to meet special needs?	1. Cite important developments in the evolution of robots. 2. Robots serve an economical and safety advantage in today's manufacturing systems. 3. List and explain the classifications of industrial robots. 4. Define the types of automation. 5. Robots do not threaten today's workers, but create new technical opportunities. 6. Robots work faster and more efficiently but reduce hostile monotonous boring tasks for today's workers.	1. What is an industrial robot? 2. What is the economic advantage of using robots in industry? 3. What are the sociological impacts of robots in manufacturing? How are robots best used in today's industry?

CURRICULUM UNIT 2 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 2 Introduction to Industrial Robotics

Conceptual Lens:

Appropriate Time Allocation (# of Days): 5 (weeks)

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AR 4	9.3.ST-ET.4		
9.3.12.AR.B4			
9.3.IT-SUP.2-3			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Early Robots: Robot literature The advent of computers Artificial intelligence Evolution of Industrial Robots: First Generation—Late 1950s through the mid-1970s Open-loop Point-to-point Pick-and-place Second Generation—Mid 1970s through the mid-1980s Programming languages Internal sensors Closed-loop control systems Third Generation—Mid 1980s to present Artificial intelligence	1. The definition of the following terms as they apply to robots and robotics: 2. Anthropomorphic 3. Artificial intelligence 4. Automaton 5. Fixed-sequenced 6. Flexible automation 7. Hard automation 8. Industrial robot 9. Intelligent robot 10. Manual manipulator 11. Numerical controlled robot 12. Playback robot 13. Reprogrammable robot 14. Robot 15. Robotics 16. Unimate 17. Variable sequenced robot	1. Examine robots in the classroom and identify their classification and type. 2. Describe how and where the word robot got its origin. 3. Describe the specific purpose of the computer and how it relates to the world of robotics 4. Explain what the early uses of robots were and how they have evolved into the work place of the 21 century. 5. Review the evolution of the industrial robot.	Learning takes place by: Reading Listening Watching Doing Problem solving 1. (Lecture/Discussion: 2. Handout- What is an Industrial 3. Handout: Types of Automation 4. Orally review Fire/Emergency Evacuation Drill	**Textbook,** pages 11–22 Review Questions, page 22 Learning Extensions, page 22 Handout Masters HM 1-1 What Is an Industrial Robot? HM 1-2 Robot Classifications HM 1-3 Three Generations of Industrial Robots Lesson Slides LS 1-1 Industrial Robots LS 1-2 Flexible Manufacturing Work Cell LS 1-3 Robot Applications	9.3.12.AR 4 9.3.12.AR.B4 9.3.IT-SUP.2-3 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 1 Quiz **Summative Assessment Summative Assessment(s)** Midterm

Sensing devices George C. Devol Early industrial robots “Unimate” Anthropomorphic PUMA What is an Industrial Robot? RIA JARA SCARA Reprogrammable Multifunction manipulator Flexible Types of Automation Hard automation Flexible automation Are Robots a threat?		6. Name the different types of industrial robots. List RIA definition of an Industrial Cite important developments in the evolution of robots. List and explain the classifications of industrial robots. Define the types of automation. Discuss the role of robots in our society					

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 3 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 3 OVERVIEW **Unit Title:** Fundamentals of Robotics

Unit Description and Objectives:

This unit will introduce students to the technical definition of an industrial robot. It will include the four basic components as well as how the robot moves in space. Working in a small group, students will create various working models of robots to visualize robot motion in the four types of coordinate systems, the type of robot motion, as well as the size and shape of work envelopes and work cells. Culminating activities will be the presentation and testing of model performance.

After studying this unit, the students will be able to:

- Identify the parts of a robot.
- Explain degrees of freedom.
- Discuss the difference between servo and non-servo robots.
- Identify and explain the different robot configurations.

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. What is the technical name for the robots hand? 2. What is meant by degrees of freedom? 3. What determines the shape of a robots work envelope?	1. Identify five major components of a robot and explain the purpose of each. 2. List and identify three types of power used in the robot actuators. 3. Explain why a human hand is able to accomplish more fluid and complex movements that a robot's gripper 4. List and describe the six degrees of freedom used by a robot.	1. What are some of the different motion control applications? 2. What is the advantage of having multiple programming methods? 3. Discuss the characteristics of the different types of programming? 4. What advantages do peripheral applications, such as vision and voice recognition give service robots?

CURRICULUM UNIT 3 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 3 -Fundamentals of Robotics

Conceptual Lens:

Appropriate Time Allocation (# of Days): 5 weeks

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.AR-PRT. 1 – 3	9.3.ST-ET.4	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12. AR – AV.1 – 2	9.3.12.AR-VIS.1 – 3		
9.3.12.AR.B4	9.3.IT-SUP.2-3		

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Parts of a robot: 1.Power supply 2.Means of programming: Computer Teach pendant 3.Controller: three levels of hierarchical control are: Level 1 Actuator control Level II Path control Level III Main control 4. Manipulator: Linear actuator Rotary actuator Tachometer 5. End effector: EOAT end of arm tooling Degrees of Freedom:	The technical name for the robots hand. Servo robots can be classified as intelligent or highly intelligent. 1. The difference between open loop and closed loop robots. 2. The three classifications for robotic motion control 3. The four methods used to program robots. 4. Pick-and-place robots are generally programmed using the manual programming	Identify the five major components of a robot and explain the purpose of each. Define Degrees of freedom as it relates to the movement of a robot Explain why a human's hand is able accomplish movement that are more fluid and complex that a robots gripper. List and explain the six degrees of freedom used for robots. Define the following terms: actuator	Learning takes place by: Reading Listening Watching Doing Thinking Problem solving 1. Lecture/Discussion: **Textbook,** pages 23–58Review Questions, page 58 Learning Extensions, page 58 Lecture/Discussion: on Handout MastersHM 2-1 Parts of a Robot HM 2-2 Relationships Among	**Textbook,** pages 23–58 Review Questions, page 58 Learning Extensions, page 58 HM 2-1 Parts of a Robot HM 2-2 Relationships Among the Five Major Robot Systems HM 2-3 Robot's Six Degrees of Freedom HM 2-4 Degrees of Freedom—Using a Spray Gun HM 2-5 Ways of Classifying Robots HM 2-6 Work	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.IT-WD. 1 - 4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** **TLA Grading** Activity sheets Laboratory Activities **Rubrics** Chapter 2 Quiz Unit 3 exam **Summative Assessment(s)** Midterm **Summative Assessment(s)** Midterm

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Three basic degrees of freedom X Y Z Six degrees of freedom 1. Rotational Traverse 2. Radial Traverse 3. Vertical Traverse 4.Pitch 5. Yaw 6' Roll Classifying Robots Non servo Servo Type of actuators: Electric Hydraulic Pneumatic Work Envelope Revolute Configuration : Vertically articulated Horizontally articulated (SCARA) Selective compliance assembly robot arm Cartesian Configuration Total linear motion Cylindrical Configuration Spherical Configuration (Polar)	method.	Cartesian configuration closed-loop system controller cylindrical configuration degrees of freedom direct-drive motor end effector error signal hierarchical control hydraulic drive linear actuator manipulator non-servo robot open-loop system pitch pneumatic drive power supply program radial traverse revolute configuration	the Five Major Robot Systems HM 2-3 Robot's Six Degrees of Freedom HM 2-4 Degrees of Freedom—Using a Spray Gun HM 2-5 Ways of Classifying Robots HM 2-6 Work Envelope Shapes –58 Review Questions, page 58 Learning Extensions, page 58	Envelope Shapes Lesson Slides LS 2-1 Robot Designed for Use in Precise Path-Oriented Tasks LS 2-2 Relationship of Five Major Robot Systems LS 2-3 Hierarchical Control LS 2-4 Types of Motion Provided by Actuators LS 2-5 Teach Pendant LS 2-6 Degrees of Freedom in the Human Hand LS 2-7 Three Basic Degrees of Freedom LS 2-8 Pitch, Yaw, and Roll LS 2-9 Robot's Six Degrees of Freedom LS 2-10 Track-			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
		roll rotary actuator rotational traverse SCARA servo amplifier servo robot spherical configuration tachometer teach pendant trajectory vertical traverse work envelope yaw		mounted Robot with Seven DOF LS 2-11 Non-servo System LS 2-12 Servo System LS 2-13 Hydraulic Actuator Drive LS 2-14 Electric Actuator Drive LS 2-15 Direct-drive Motor LS 2-16 Revolute Configuration—Vertically Articulated LS 2-17 SCARA Configuration LS 2-18 Cartesian Configuration LS 2-19 Cylindrical Configuration LS 2-20 Spherical Configuration			

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 4 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 4 OVERVIEW **Unit Title:** Programming the Robot

Unit Description and Objectives:

This unit will introduce students to the technical definition of an industrial robot. It will include the four basic components as well as how the robot moves in space. While working in small groups, students will create various working models of robots to visualize robot motion in the four types of coordinate systems, the type of robot motion, as well as the size and shape of work envelopes and work cells. Culminating activities will be the presentation and testing of model performance.

After studying this unit, the students will be able to:

- Identify the different motion control applications.
- Explain the various programming methods.
- Discuss the characteristics of the different types of programming.
- Describe various peripheral applications, such as vision and voice recognition

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. Why are there different motion control applications? 2. What are some of the advantages of having various programming methods? 3. Discuss the characteristics of the different types of programming. 4. How have various peripheral applications, such as vision and voice recognition become part of today's robots?	1. Industrial robots operate on computer programs. 2. Proper programming techniques are needed for successful robot operation. 3. Programs are also needed to operate peripheral equipment. 4. Writing, editing, and saving computer programs is a necessary skill for robot technicians.	1. What computer skills are needed for robot technicians? 2. How do you program a robot? 3. How do computer programs help us communicate with industrial robots?

CURRICULUM UNIT 4 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 4 Programming the Robot

Conceptual Lens:

Appropriate Time Allocation (# of Days): 5 weeks

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.12.AR.B4	9.3.IT.7	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.IT-SUP.2-3	
9.3.12. AR – AV.1 – 2	9.3.12.AR-VIS.1 – 3	9.3.ST-ET.4	

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment
History 1. The three periods are: 2. The three classifications for robotic motion control: 3. The robot duplicates only the recorded movements during playback. The four methods used to program robots are: Pick-and-place robots are generally programmed using the manual programming	1. Students will be able to briefly trace the evolution of the industrial robot. 2. Students will define the term industrial robot 3. Describe the most common need/use of robots in industry. 4. Explain the economic advantage of using robots in the automotive and electronics manufacturing industry. 5. Describe the most common misconceptions about the use of robots in manufacturing today.	1. Identify the different motion control applications. 2. Explain the various programming methods. 3. Discuss the characteristics of the different types of programming. Describe various peripheral applications, such as vision and voice recognition. **Define the following terms:** artificial intelligence (AI) compiler continuous-path (CP) motion end stop hierarchical control	**Textbook,** pages 59–80 Review Questions, page 80 Learning Extensions, page 80 **Laboratory Manual,** pages 7–26 Activity 3-1—Programming Environment, pages 7–8 Activity 3-2—Axis Movement Commands, pages 9–10 Activity 3-3—Circular Interpolation Commands, pages 11–12 Activity 3-4—Delay or Timer Commands, page 13Activity 3-5—Speed Control Commands, pages	**Textbook,** pages 59–80 Review Questions, page 80 Learning Extensions, page 802w` *Chapter 3* *Programming the Robot* 1 Handout Masters HM 3-1 Evolution of Programming HM 3-2 Motion Control HM 3-3 Common Programming Languages HM 3-4 Common Task-level Programming Functions Lesson SlidesLS 3-1 Manual Programming LS 3-2 Teach Pendant	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 - 4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 3 exam **Unit 4 exam** **Summative Assessment(s)** Midterm

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment
method. Computer programming provides greater flexibility. It is not necessary to take a robot out of operation while the program is being written and debugged, so productivity is not affected. In task-level programming, Reduce the complexity of programming and reprogramming a robot as the tasks and processes change Hierarchical control programming There is no standard robot programming	6. Describe productivity and economic impacts when applying robots in the manufacturing industry.	programming high-level language manual programming manual rate control box off-line programming on-line programming pick-and-place motion point-to-point (PTP) motion sensory feedback subroutine task-level programming teach pendant programming voice recognition walk-through programming WAVE	15–16 Activity 3-6—Program Control GOTO Function, pages 17–18 Activity 3-7—Program Control If...Then...Else, pages 19–20 Activity 3-8—Program Control Subroutines, pages 21–22 Activity 3-9—Program Control Repetition, pages 23–24 Activity 3-10—Robot I/O, pages 25–26 **Instructor's CD** ***Robotics*** Permission granted to reproduce for educational use only. Copyright by Goodheart-Willcox Co., Inc. *Programming the Robot* 1 Chapter 3 **Programming the Robot** Handout Masters HM 3-1 Evolution of Programming HM 3-2 Motion Control HM 3-3 Common Programming	Programming LS 3-3 Hierarchical Control Programming LS 3-4 Task-level Programming LS 3-5 Programming Screen **Effective Instructional Strategies** Cognitive Domain (Levels of Knowledge) a. Knowledge (remember) b. Comprehension (understand) c. Application (use) d. Analysis (take part) e. Synthesis (create new) f. Evaluation (judge) 4. Psychomotor Domain (Levels of Skill) • Imitation • Manipulation • Precision • Articulation • Naturalization 5. Affective Domain (Levels of Attitude) • Receiving • Responding • Valuing • Organizing • Characterizing			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment
language for all the robotic equipment in the company. Misconceptions about Robots A. Productivity B. Intelligent Machines C. Labor Costs D. Job Loss E. Economic Issues Automotive and Electronics industry Non-economic Factors in Robot Use A. Hostile Environment B. Monotonous Jobs C. Competition Robot Selection A. Need/Use B. Cost IMC research on the following topics: A. History of robotics B. Present day robot applications. C. Future applications			Languages HM 3-4 Common Task-level Programming Functions Lesson Slides LS 3-1 Manual Programming LS 3-2 Teach Pendant Programming LS 3-3 Hierarchical Control Programming LS 3-4 Task-level Programming LS 3-5 Programming Screens Chapter 3 Quiz **Effective Instructional Strategies** 1. Cognitive Domain (Levels of Knowledge) a. Knowledge(remember) b. Comprehension (understand) c. Application (use) d. Analysis(take part) e. Synthesis (create new) f. Evaluation	The parts of an instructional objective should include the task, conditions, and standards. The task specifies what the student should be able to do. Conditions specify what is needed to perform a task. Finally, standards specify the degree of accuracy. **The Teaching-Learning Process** A knowledge of the teaching-learning process helps an instructor facilitate student learning. There are many considerations in understanding how we learn and how efficient learning takes place. Psychologists have studied human development and learning processes for many years. The discipline of educational psychology has helped to develop theories of learning. The results of educational research have helped instructors in the organization of programs and utilization of appropriate strategies to promote learning. As instructors, we must always keep in mind the characteristics and needs of our students. We consider such factors as individual differences and diversity. All teachers should be aware of the use of appropriate strategies during all phases of the teaching-learning process.			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment
			(judge) 2. Psychomotor Domain (Levels of Skill) • Imitation • Manipulation • Precision • Articulation • Naturalization 3. Affective Domain (Levels of Attitude) • Receiving • Responding • Valuing • Organizing • Characterizing	6. Learning takes place by: Reading Listening Watching Doing Thinking Problem solving			

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 5 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 5 OVERVIEW **Unit Title:** Industrial Applications

Unit Description and Objectives:

This unit will introduce students to the three methods of moving robots. These methods include electrical, pneumatic, and hydraulic power systems. Knowledge of simple machines and mechanical advantages is stressed. Students will be designing and constructing simple robot structures that will incorporate the three power systems. Culminating activities will be the presenting and testing of models.

After studying this unit, the students will be able to:

- Describe how robots are integrated into a manufacturing process.
- Select the proper robot for a given task.
- Identify processes where robots are used.
- List peripheral devices used to complete tasks.

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. What key design criteria should product engineers consider? 2. When in manufacturing would it be more productive to let human workers or dedicated machines assemble rather than to incorporate robots? 3. What is the difference between accuracy and repeatability?	1. Soldering techniques and mechanical skills are requirements to building and constructing robots. 2. Feedback systems along with input / output commands are part of any service or industrial robot. 3. Service and industrial robots differ from "toy robots" in that they are multifunctional, reprogrammable manipulators.	1. What electrical mechanical skills are needed for today's robot technicians? 2. What are the needs and uses of a service type robot? 3. What is the difference between a "toy robot" and an industrial grade robot?

CURRICULUM UNIT 5 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 5 - Industrial Applications

Conceptual Lens:

Appropriate Time Allocation (# of Days): 5 weeks

Primary Content Standards referenced With Cumulative Progress Indicators			
9.3.12.AC-DES.1 – 2	9.3.12.AR-VIS.1 – 3		
9.3.12. AR – AV.1 – 2	9.3.IT-SUP.2-3		
9.3	9.3.ST-ET.4		

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
A. Soldering techniques and PC board assembly. 1. Review 2. Robot assembly B. Mechanical assembly 1. Gears 2. Pulleys 3. Linkages C. Electrical assembly 1. Motors 2. Sensors D. Robot testing and Evaluation E. Report	1. Each student group will be able to describe the operational principle for the types of robots. 2. Describe the operation of a sound operated service robot. 3. Describe the operation of an infra-red line tracing service robot. 4. The definition of the following terms: accuracy	1. Working in groups of 2-3, students will successfully construct and test the two types of robots listed above. 2. Each student group will be able to apply the const. principles of the kits to future robot design of their own. 3. Each student group will submit a written report describing the operational principles of the types of robots and two other uses of service robot technology.	* Learning takes place by: Reading Listening Watching Doing Thinking Problem solving Review all safety procedures and discuss clean up procedures	**Textbook,** pages 81–113 Review Questions, page 113 Learning Extensions, page 113 **Laboratory Manual,** pages 27–40 Activity 4-1—Palletizing, pages 27–31 Activity 4-2—Control with DC Stepping Motors, pages 33–36 Activity 4-3—Automatic Stepping Motor Control, pages 37–40 Handout Master HM 4-1 Degrees of Freedom and	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 4 Quiz Chapter 4 Exam A Chapter 4 Exam B Chapter 4 Exam C Chapter 4 Quiz **Unit 5 exam**

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
	automated guided vehicle (AGV) command resolution design for manufacturability dynamic performance fixturing interlocks light curtain operational speed payload pressure sensitive safety mat repeatability resolution service robot spatial resolution		* Practice PC soldering • Working in groups of 2-3, construct the two types of service robots Test operation *Written report on operation principles *working with all necessary soldering equipment and supplies *Sound op. robot kit construction *Infra-red robot kit construction	Corresponding Axes Lesson Slides LS 4-1 Safety Barrier LS 4-2 Safety Sensors LS 4-3 Palletizing LS 4-4 Loading and Unloading LS 4-5 Die Casting LS 4-6 Welding LS 4-7 Spray Painting LS 4-8 Gluing LS 4-9 Gas Torch Cutting LS 4-10 Inspection LS 4-11 Robots for Consumer Use			**Summative Assessment(s)** Midterm

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 6 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 6 OVERVIEW **Unit Title:** I. Power Supplies and Movement Systems

Unit Description and Objectives:

This unit will introduce students to the three methods of moving robots. These methods include electrical, pneumatic, and hydraulic power systems. Knowledge of simple machines and mechanical advantages is stressed. Students will be designing and constructing simple robot structures that will incorporate the three power systems. Culminating activities will be the presenting and testing of models.

After studying this chapter, the students will be able to:

- Discuss the use of electromechanical systems with robots.
- Explain the function of control systems used with robots.
- Summarize the characteristics of direct current, single-phase ac, and three-phase ac motors.
- Describe the type of motion that rotary electric actuators produce.

Essential Questions and Enduring Understandings:

1. How does a simple electric motor work? 2. What applications require pneumatic or hydraulic power systems? 3. What are simple machines and how do they aid in task completion?	1. Robots systems are made up of four basic components. 2. Robots move in various ways to create a work envelope. 3. Robot motion will move within a coordinate system. 4. A work cell includes the work envelope along with the basic components of the robot system. 5. Electric motors are simple magnetic devices used in most robot manipulators. 6. Pneumatic and hydraulic power systems are used for different payload needs.	1. What is an industrial robot? 2. What are the basic components of the robot system? 3. How does a robot move in a work envelope? 4. What does a work cell include? 5. What are the four types of coordinate systems of robot motion?

CURRICULUM UNIT 6 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 6- Power Supplies and Movement Systems

Conceptual Lens:

Appropriate Time Allocation (# of Days)**:** 5 weeks

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.12.AR.B4	9.3.IT.7	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.IT-SUP.2-3	
9.3.12. AR – AV.1 – 2	9.3.12.AR-VIS.1 – 3	9.3.ST-ET.4	

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Electrical Power Systems A. Permanent Magnet Motors 1. Parts 2. Operation Principles 3. Uses B. Universal Motors 1. Parts 2. Operation Principles--Series, Shunt, Compound 3. Uses C. AC Synchronous Motors 1. Parts 2. Operation Principles 3. Uses D. Stepper/Servo Motors 1. Parts	1. Each student will know and be able to describe the need/operation of each of the basic parts of DC motor. 2. Describe how electromagnetic fields effect motor operation. 3. Describe the need of internal components in electric motors. 4. List the different uses of specific types of motors. 5. Describe the need of feedback systems for motor position. 6. Describe a pneumatic fluid power system. 7. Describe a hydraulic fluid power system. 8. Use Pascal's Law to describe	1. Each student will be able to explain how varying source voltage can control the speed of a universal motor. 2. Each student will be able to list two uses of each type of motor in the unit. 3. Each student will be able to describe an optical encoder and its need for motor positioning. 4. All students will be able to describe the principles of operation for hydraulic and pneumatic power systems. 5. Each student will be able to list and define Pascal's Laws as they apply to fluid power. 6. All students will be able to diagram and describe linear and rotary actuators used in fluid power systems. 7. Working in groups and following established safety steps, all students will complete TLA to reinforce fluid power principles and robot motion/ degrees of freedom.	*Reading assignments *Discuss and label the following parts of a DC motor: field, armature, commutator, and brushes *Discuss electromagnetic fields used in universal motors *Discuss operation with AC or DC current *TLA: Construct a single phase synchronous motor and test for proper operation *Discuss speed of synchronous motor and line frequency *Diagram motor parts and discuss alternating field *Discuss uses of synchronous type motor *Discussion/notes on content areas. *TLA: Design/construct a simple device to move an object using simple machines.	**Textbook,** pages 115–138 Review Questions, page 138 Learning Extensions, page 138 **Laboratory Manual,** pages 41–75 Activity 5-1—Basic Electrical Symbols, pages 41–42 Activity 5-2—Electrical Components, Equipment, and Symbols, pages 43–46 Activity 5-3—Electrical Meters, pages 47–49 Activity 5-4—Industrial Electronic	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 5 Quiz **Unit 6 exam** **Summative Assessment(s)** Final Exam

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
2. Operation Principles 3. Uses E. Adv. /Disadv. of Motors F. Feedback Systems 1. Optical Encoders 2. Current Limiters <u>Mechanical Systems</u> A. Mechanical Advantage B. Simple Machines 1. Levers 2. Wheel & Axle 3. Pulley 4. Inclined Plane 5. Wedge 6. Screw <u>Fluid Power Systems</u> A. Pascal's Laws B. Hydraulic Power 1. Principles 2. Actuators 3. Adv. / Disadv C. Pneumatic Power 1. Principles 2. Actuators 3. Adv. / Disadv	a simple fluid power system operation. 9. Explain the terms force, pressure, work, and power, as applied to fluid power systems. 10. Describe the operation of linear and rotary fluid power actuators.		*TLA: Design/construct simple hydraulic and pneumatic actuators to lift or move various objects. (linear and rotary) *TLA: Design/construct end- effector /gripper with pneumatic control to grasp and move a payload. *Review all safety steps for using hand tools, power hand tools and bench power tools. *Text *Lab experiments *Bench equipment *Demo motors *Reading materials *Handouts *Diagrams *Visual aids *Wood/Plastic/PVC *Glue/fasteners *Tubing/plungers *Various weights *Food coloring *Water	Symbols, pages 51–53 Activity 5-5—Basic Electrical Problem Solving, pages 55–56 Activity 5-6—Industrial Symbols and Diagrams, pages 57–59 Activity 5-7—Control Systems Overview, pages 61–62Activity 5-8—AC Synchronous Motors, pages 63–64Activity 5-9—DC Stepping Motors, pages 65–66Activity 5-10—Solenoids, pages 67–69Activity 5-11—Motor-Driven Timers, pages 71–72Activity 5-12—Digital Timers, pages 73–75 Handout MastersHM HM 5-1 Automated System Parts HM 5-2 Closed-loop Systems HM 5-3 DC Motor			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
				Parts HM 5-4 Basic Categories of DC Motors HM 5-5 Single-phase AC Motors HM 5-6 Three-phase AC Induction Motor HM 5-7 Servo System Lesson Slides LS 5-1 Conveyor Sensing System LS 5-2 Closed-loop System LS 5-3 Closed-loop System with Automatic Adjustment LS 5-4 DC Motor Parts LS 5-5 DC Motor Operating Characteristics LS 5-6 Compound-wound DC Motor LS 5-7 Three-			

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 7 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 7 OVERVIEW **Unit Title:** Sensing and End of Arm Tooling

Unit Description and Objectives:
Understanding how robots are controlled with sensing systems. This unit covers sensing systems, and devices called transducers that convert light, heat, or mechanical energy into electrical energy. The signal output of the transducer affects the operation of the robot's end effector. This unit also explores the (EOAT) "end of arm tooling". EOATs are attached to the wrist of the manipulators and can grasp, lift, transport, maneuver, or perform operations on a work piece.

After studying this chapter, the students will be able to:

- Explain the function of transducers in the operation of sensors. * Identify the various sensors used in an automated system.
- Describe how sensors are integrated into an automated system. * Discuss the similarities and differences between the movement of an end effector and the human hand.
- Explain the operation of various types of grippers used in robotic applications. * Describe the difference between end effector grippers and end effector tools.
- Identify the benefits of changeable end effectors. * List important factors and desirable characteristics to be considered in the design of end.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations** **Students will understand that:**	**Guiding Questions**
1. What is the purpose of equipping a robot with a sensing system? 2. What is a transducer? 3. What is the difference between infra-red and Ultra violet sensors??	Explain the function of transducers in the operation of sensors. Identify the various sensors used in an automated system. Describe how sensors are integrated into an automated system.	1. How can you use a sensor to measure depth? 2. How do end effectors differ from the human hand? 3. What are the major classifications of end effectors? 4. When would you choose a vacuum gripper over an electromechanical gripper?

CURRICULUM UNIT 7 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 7- Sensing and End of Arm Tooling

Conceptual Lens:

Appropriate Time Allocation (# of Days)**:** **2 weeks**

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.ST-ET.4	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12. AR – AV.1 – 2	9.3.IT.7		
9.3.12.AR.B4	9.3.IT-SUP.2-3		

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Proximity Detectors, pages LVDT Detector, *Sensors* 1 light-emitting diode (LED) limit switch magnetic field sensor microswitch nanometer (nm) optical fibers optical proximity sensor opto-electronic photoconductive device	1. Know the definition of the following terms: acoustical proximity sensor angstrom (Å) capacitance capacitive transducer computer vision sensor eddy current proximity sensor electromagnetic spectrum inductance inductive transducer	Explain the function of transducers in the operation of sensors. Identify the various sensors used in an automated system. Describe how sensors are integrated into an automated system. Discuss the similarities and differences between the movement of an end effector and the human hand. Explain the operation	*Reading assignments *Discuss and label the following parts of a DC motor: field, armature, commutator, and brushes *Discuss electromagnetic fields used in universal motors *Discuss operation with AC or DC current *TLA: Construct a single phase synchronous motor and test for proper operation *Discuss speed of synchronous motor and line frequency *Diagram motor parts and discuss alternating field *Discuss uses of synchronous type motor *Discussion/notes on content areas. *TLA: Design/construct a simple device to move an object using simple machines. *TLA: Design/construct simple hydraulic and pneumatic actuators to lift or move various objects. (linear and rotary) *TLA: Design/construct end- effector /gripper with pneumatic control to grasp and move a payload.	**Textbook,** pages 171–194 Review Questions, page 194 Learning Extensions, page 194 **Laboratory Manual,** pages 119–133 Activity 7-1—Proximity Detectors, pages 119–122 Activity 7-2—LVDT Detector, pages 123–125 **Instructor's CD** ***Robotics*** Permission granted to reproduce for educational use only. Copyright by Goodheart-Willcox Co., Inc. *Chapter 7*	9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B 4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 7 Quiz Chapter 8 Quiz **Unit 7 exam** **Summative Assessment(s)** Final Exam

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
photoemissive device photovoltaic device piezoelectric effect proximity sensor range sensor reedswitch resistive transducer sound sensor speed sensing stadimetry strain gauge tactile sensor thermistor thermocouple thermoelectric sensor touch-sensitive proximity sensor transducer triangulation ultraviolet sensor	infrared sensor laser laser interferometric gauge light-emitting diode (LED) limit switch magnetic field sensor microswitch nanometer (nm) optical fibers optical proximitysensor opto-electronic photoconductive device photoemissive device photovoltaic device piezoelectric effect proximity sensor range sensor reed switch resistive transducer	of various types of grippers used in robotic applications. Describe the difference between end effector grippers and end effector tools. Identify the benefits of changeable end effectors. List important factors and desirable characteristics to be considered in the design of end effectors.	*Review all safety steps for using hand tools, power hand tools and bench power tools. *Text *Lab experiments *Bench equipment *Demo motors *Reading materials *Handouts *Diagrams *Visual aids *Wood/Plastic/PVC *Glue/fasteners *Tubing/plungers *Various weights *Food coloring *Water	*Sensors* 1 light-emitting diode (LED) limit switch magnetic field sensor microswitch nanometer (nm) optical fibers optical proximity sensor opto-electronic photoconductive device photoemissive device photovoltaic device piezoelectric effect proximity sensor range sensor reed switch resistive transducer sound sensor speed sensing stadimetry strain gauge tactile sensor thermistor thermocouple thermoelectric sensor touch-sensitive proximity sensor transducer triangulation			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
X-rays Photoelectric Sensors, Temperature Sensor Thermocouple Applications, Resistive, Capacitive, and Inductive Sensors Linear Variable Differential Transformer (LVDT) Electromagnetic Spectrum Cadmium Sulfide Cell Optics Ruby Laser Gas Laser Semiconductor Laser	sound sensor speed sensing stadimetry strain gauge tactile sensor thermistor thermocouple thermoelectric sensor t ouch-sensitive proximity sensor transducer triangulation ultraviolet sensor X-rays automatic tool changer collet gripper compliance cylindrical grip electromechanical gripper			ultraviolet sensor X-rays Chapter 7 **Sensors** Activity 7-3—Photoelectric Sensors, pages 127–128 Activity 7-4—Temperature Sensors, pages 129–130 Activity 7-5—Thermocouple Applications, pages 131–133 **Textbook,** pages 195–209 Review Questions, page 209 Learning Extensions, page 209 **Instructor's CD** Handout Masters HM 8-1 Prehensile and Nonprehensile Movements HM 8-2 Gripper End Effectors Lesson Slides LS 8-1 Mechanical Finger Grippers LS 8-2 Two-finger Gripper LS 8-3			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Speed Sensors 7-12 Strain Gauge Limit Switches Prehensile and Nonprehensile Movements Gripper End Effectors Mechanical Finger Grippers Two-finger Gripper Three-finger Grippers Vacuum Gripper Automatic Tool Changer	expandable gripper gripper hook movement lateral grip magnetic gripper mechanical finger gripper nonprehensile movement oppositional grip overload sensor palmar grip prehensile movement remote-center compliance (RCC) device spherical grip spread movement tool vacuum gripper			Three-finger Grippers **Instructor's CD *Robotics*** Permission granted to reproduce for educational use only. Copyright by Goodheart-Willcox Co., Inc. *Chapter 8* *End Effectors* 1 LS 8-4 Vacuum Gripper LS 8-5 Automatic Tool Changer			

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

			learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	

UNIT 8 OVERVIEW

Course title: Introduction to Robotics

Unit Title: Control Systems and Maintenance

Unit #: UNIT 8 OVERVIEW

Description and Objectives: The heart of the robotic control system is a microprocessor linked to input /output and monitoring systems. This unit will explore the series of instructions stored in the robots program memory, and touch upon computer systems used, digital electronics interfacing. The students will engage in troubleshooting and servicing techniques that will enable repair and or reprogramming or preventative maintenance necessary to keep the robots in operation.

After studying this chapter, the students will be able to:

- Understand what a bit of information represents.
- Identify the function of a computer system's basic components.
- Explain the basic functions of a computer system.
- Summarize the characteristics and function of the binary number system.
- Apply the conversion formulas for binary, octal, and hexadecimal number systems.
- Identify common types of logic gates.
- Explain how flip-flops are used in binary counters.
- Understand the purpose of instructions in computer programming.
- Understand the purpose of interfacing robotic systems.
- Explain the hardware options for interfacing multiple systems.
- Identify the types of robotic operations that use machine vision systems.
- Explain the four functions that take place during image processing.

Essential Questions and Enduring Understandings:

Essential Questions:	**Enduring Understandings/Generalizations** **Students will understand that:**	**Guiding Questions**
1. What is the job of the micro-processor? 2. How are words translated into numbers when writing code for a program? 3. What computer skills are needed for robot technicians? 2. How do you program a robot? 3. How do computer programs help us communicate with industrial robots?	1. The CNC process is faster and more efficient in manufacturing parts. 2. Computer programming is needed as part of this process. 3. Robots can also be integrated with CNC equipment to develop a manufacturing work cell.	1. What does CNC stand for? 2. What are the principles of CNC manufacturing? 3. How can CNC machining operation improve productivity? 4. What is flexible manufacturing?

CURRICULUM UNIT 8 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 8- Control Systems and Maintenance

Conceptual Lens:

Appropriate Time Allocation (# of Days)**:** 5 weeks

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.12.AR.B4	9.3.IT.7	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.IT-SUP.2-3	
9.3.12. AR – AV.1 – 2	9.3.12.AR-VIS.1 – 3	9.3.ST-ET.4	

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Computer systems Microprocessor Buses Memory Basic functions Timing fetch & execute Read Write Input output transfer interrupt Digital Numbering system Binary number system Binary-coded decimal number system Octal numbering systems Hexadecimal numbering system	The definition of the following terms. accumulator address register analog information AND gate arithmetic logic unit (ALU) binary-coded-decimal (BCD) number system binary counter binary logic circuit binary number system binary point bistable device bit bus network byte central processing unit	Understand what a bit of information represents. Identify the function of a computer system's basic components. Explain the basic functions of a computer system. Summarize the characteristics and function of the binary number system. Apply the conversion formulas for binary, octal, and hexadecimal number systems. Identify common types	**Textbook,** pages 211–240 Review Questions, page 240 Learning Extensions, page 240 **Laboratory Manual,** pages 135–144 Activity 9-1—Digital Logic Functions, pages 135–138 Activity 9-2—Combination Logic Gates, pages 139–144 Handout Masters HM 9-1 Microprocessor HM 9-2 Conversions: Binary-to-Base 10 and Decimal-to-Binary HM 9-3 Conversions: Binary-Coded-Decimal (BCD) Number System HM 9-4 Conversions: Octal-to-	**Lecture Notes** **Lab Benches /** **AC/DC Variable Power supply** **Electrical & Electronic experimenter parts** **Multi meters/** **Oscilloscope** **Educational Kits** Calculators FACET 13, 13-1, 13-2, 13,3	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 9 Quiz Chapter 10 Quiz **Unit 9 exam** **Summative Assessment(s)** Final Exam

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Binary logic circuits Logic gates And Or Nor Flip flops Digital counters Binary counters Decade counters Counterprogramming Instructions Program planning	The definition of the following terms. (CPU) control unit counter data register decade counter decoder unit digital electronics digital information dynamic RAM (DRAM) electrically erasable programmable read-only memory (EEPROM) erasable programmable read-only memory (EPROM) execute fetch firmware flip-flop hexadecimal number system input-output (I/O) transfer interrupt inverter logic circuit logic gate memory microprocessor unit (MPU) MPU cycle The definition of the following terms. The definition of the following terms.	of logic gates. Explain how flip-flops are used in binary counters. Explain the purpose of interfacing robotic systems. Explain the hardware options for interfacing multiple systems. Identify the types of robotic operations that use machine vision systems. Explain the four functions that take place during image processing.	Decimal and Decimal-to-Octal HM 9-5 Conversions: Octal-to-Binary and Binary-to-Octal HM 9-6 Conversions: Hexidecimal-to-Decimal and Decimal-to-Hexidecimal HM 9-7 Conversions: Hexidecimal-to-Binary and Binary-to-Hexidecimal HM 9-8 AND Gate HM 9-9 OR Gate HM 9-10 NOT Gate HM 9-11 Combination Gates HM 9-12 R-S Flip-Flop HM 9-13 R-S-T Flip-Flop HM 9-14 JK Flip-Flop HM 9-15 Flowchart Symbols Lesson Slides LS 9-1 Microprocessor LS 9-2 Bus Network LS 9-3 MPU Address Bus Handout Masters HM 10-1 Digital Input Port HM 10-2 Digital Output Port	Overhead projector Demo D'Arsonval movement FACET equipment All necessary safety supplies Soldering supplies and tools Hot glue guns. Masonite - 5"x7". Multi-meter kit and lab manual 3 essential multi-meter labs testing their knowledge base of using their own constructed kit meter and measuring: Voltage Amperage Resistance			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
	NAND gate NOR gate NOT gate octal number system OR gateperiod personal computer (PC) place value positive logicprogram counter programmable read-only memory (PROM) random access memory (RAM) read-only memory (ROM) register unit software static RAM (SRAM) truth table		HM 10-3 Machine Vision System Lesson Slides LS 10-1 Digital Input Port LS 10-2 Digital Output Port LS 10-3 Interfacing Application LS 10-4 GPIB Interface Bus LS 10-5 Machine Vision System LS 10-6 Image Analysis				

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 9 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 9 OVERVIEW **Unit Title:** Mobile Robots, Construction, Programming, & Applications

Unit Description and Objectives:

This unit will introduce students to the CNC process of manufacturing. Computer applications will include writing programs for the CNC mill and lathe to produce parts as well as individual class projects. These skills will be used to produce parts for the culminating design problem and final project, the mobile robot required in Unit 10. Students will also be introduced to the concept of flexible manufacturing whereby industrial robots are incorporated with CNC equipment to aid in the manufacturing of goods and products.

After studying this chapter, the students will be able to:

- Each student will be able to describe the needs of CNC in today's manufacturing industry.
- Using the computer, each student will be able to write a simple engraving program for the CNC mill.
- Using the computer and the CNC mill, each student will demonstrate working knowledge of the CNC mill by properly programming and machining a designed part to specifications.
- Using the computer and CNC lathe, each student will
- Demonstrate working knowledge of the CNC lathe by properly machining a designed part to specifications.
- Each student will be able to describe a flexible manufacturing system and its uses in industry today.
- All students will be able to design a simple FMS and describe the advantages and disadvantages of such a system.
- Working in groups, all students will develop and operate a simple FMS work cell to produce a part.

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. What is the difference between a fixed robot and a moveable robot? 2. What is flexible manufacturing? 3. What are the advantages of mobile robots and what areas are they being used in today?	1. Mobile robots can be used in varied applications. 2. There are four component parts to any mobile robot. 3. Mobile robots can complete tasks deemed too dangerous for humans.	1. What are mobile robots? 2. Why are they needed and used in today's world? 3. What are the advantages and disadvantages of using mobile robots?

CURRICULUM UNIT 9 PLAN

Course Title/Grade: Introduction to Robotics

Unit Number/Title: 9 - Mobile Robots, Construction, Programming, & Applications

Conceptual Lens:

Appropriate Time Allocation (# of Days): **2 weeks**

Primary Content Standards referenced With Cumulative Progress Indicators

9.3.12.AC-DES.1 – 2	9.3.AR-PRT. 1 – 3	9.3.IT-SUP.2-3	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12. AR – AV.1 – 2	9.3.12.AR-VIS.1 – 3		
9.3.12.AR.B4			

Topics/Concepts (Incl. time / # days per topic)	Critical Content Students Will Know:	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
Computer Application A. Intro to Scorbase Robot Programming 1. Command Language 2. Input/output 3. Principles 4. Writing Programs 5. Off-Line 6. Programming B. Robot Control Principles 1. Safety 2. Axis Control 3. Keyboard Commands 4. Teach Pendant 5. On-Line Programming	1. Develop computer application skills through robot control and programming. 2. Develop programming skills through robot task analysis and solution. 3. Complete on-line/off-line program solutions. 4. Describe basic programming methods used with industrial robots.	1. Each student will be able to develop a program to move the robot through a three-position cycle using the computer and Scorbot equipment. 2. Each student will be able to write and save an off-line program using the computer. 3. All students will be able to write, test, save, and print a Scorbase program using the computer.	*Reading assignments *Discussion/notes on content areas *Use computers to develop programs for robot operation *Develop simple robot routine *Design and build additional peripheral equipment for various job/programs. *Writing robot programs using variables for sorting. *Hand-off operations between robots using variables and input/output commands for robot communication.	*Reading assignments *History of mobile robots *Discussion/notes on content areas. *Discussion/notes on four basic parts of mobile robots. *Discussion on requirements of mobile robot TLA *Design, construct and test a mobile robot to meet TLA specifications. *Mobile robot TLA competition. *Drafting supplies *Construction and materials / supplies to include plastic, wood, various gules, fastener supplies.	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	Formative Assessments: *Individual & group projects *Portfolio documentation *Research & oral presentations * Mobile robot TLA competition. **Unit 8 exam** Summative Assessment(s) Final Exam

Topics/Concepts (Incl. time / # days per topic)	Critical Content Students Will Know:	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
to Teach Positions C. Use of Robot Peripherals 1. Slide base 2. Conveyor 3. Rotary table D. Program Task Solutions for: 1. Pick / Place 2. Palletizing 3. Sorting 4. Hand-off operation 1. Design Applications 2. Component Parts a. Propulsion communicate censors d. Manipulator 3. Designs and uses.	5. Describe and compare three methods used to program robots. 6. List all safety steps to follow for robot operationMobile robot technology and its present day applications. 7. Benefits or advantages of using mobile robots. 8. Working in teams, students will design and develop radio controlled robots to compete in a Robot Assessment Task design solution competition.	4. Each student will be able to describe necessary safety steps to follow when programming and operating a robot. 5. Each student will be able to operate all Scorbase peripheral for a given robot task. 6. Each student will be able to write and program an operating solution for each of the four Robot program tasks. All students will be able to describe the four basic parts of mobile robots. 7. Research mobile robot design concepts	* See attached TLA *Reading materials *Handouts *Diagrams *Scorbot ER-V *Teach Pendant *PC *Floppy disks *Reading assignments *History of mobile robots *Discussion/notes on content areas. *Discussion/notes on four basic parts of mobile robots. *Discussion on requirements of mobile robot TLA *Design, construct and test a mobile robot to meet TLA specifications. *Mobile robot TLA competition. *Drafting supplies *Construction and materials / supplies to include plastic, wood,	*Radio and receiver for mobile robots with four servo motors. * Necessary hand and power tools.			

Topics/Concepts (Incl. time / # days per topic)	**Critical Content** Students Will Know:	**Skill Objectives** (Students Will Be Able To:)	**Instructional/Learning Activities & Interdisciplinary Connections**	**Instructional Resources**	**Technology & 21st C Skills Integration (Specify)**	**NJSLS w/ CPI Reference**	**Evaluation/ Assessment:**
		8. Each student will be able to list and describe three present day applications of mobile robots. 9. Design, develop & construct and test a radio controlled robot for class competition.	various gules, fastener supplies. *Radio and receiver for mobile robots with four servo motors. * Necessary hand and power tools.				

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

UNIT 10 OVERVIEW

Course Title: Introduction to Robotics

Unit #: UNIT 10 OVERVIEW **Unit Title:** Robots in Future of Manufacturing.

Unit Description and Objectives:

This unit will explore the world of manufacturing that is customer driven. We will address some business decisions related to the use of robots, the advantages of implementing robotics systems in manufacturing environment, and how to develop an implementation plan. This unit presents developments that impact the factory of the future, non–factory robots, artificial intelligence, and worker training programs. Students will research careers in the Robotics and identify areas of concentration that are utilizing robots as a work force. Their final project will be to construct a mobile remote controlled robot that will incorporate the knowledge and experience they have gained throughout the course over the past 10 units.

After studying this chapter, the students will be able to:

- Each student will be able to design, construct and operate a remote controlled using a four channel Radio transmitter and receiver with 4 dc servo motors.
- Each student will participate in a technology learning activity that will allow them to follow the problem solving design loop and complete the TLA to the best of their ability using the information and knowledge gained throughout the year to prepare for a mobile robot competition that will require the skills that were explored throughout the ten units covered in this curriculum.
- This activity will be part of their final assessment and examination for the course work.

Essential Questions and Enduring Understandings:

Essential Questions:	Enduring Understandings/Generalizations Students will understand that:	Guiding Questions
1. Why were robots first used in industry for manufacturing rather than some of the exciting areas of the world they are now becoming integrated into today? 2. Why would a company spend a large investment in such a machine that still needs to be set up by human interaction? 3. What would be the main concern for the human work force in todays' production systems that are implementing robots?	1. How is manufacturing affected by economics? 2. How can essential manufacturing continue to produce cost effective profits while keeping up with cutting edge technology? 3. What would be a few specific undesirable working environments where robots are an effective solutions? 4. What is Telerobotics? 5. What are the three areas of artificial intelligence?	1. What would be an area where we may fine fully automated Factories?? 2. How can artificial intelligence be implemented into today's robot systems and what would they be able to replace the human brain for analytical thinking? 3. Although robots are actually not faster in the production process what makes them more dependable in the assembling process" 4. What type of work and information should be included in a professional portfolio?

CURRICULUM UNIT 10 PLAN

		Primary Content Standards referenced With Cumulative Progress Indicators			
Course Title/Grade:	**Introduction to Robotics**				
Unit Number/Title:	**10 - Robots in Future of Manufacturing**	9.3.12.AC-DES.1 – 2	9.3.IT-SUP.2-3		
Conceptual Lens:		9.3.12. AR – AV.1 -2	9.3.ST-ET.4		
Appropriate Time Allocation (# of Days)**:**	**4 weeks**	9.3.12.AR-VIS.1 – 3			

Topics/Concepts (Incl. time / # days per topic)	Critical Content (Students Will Know:)	Skill Objectives (Students Will Be Able To:)	Instructional/Learning Activities & Interdisciplinary Connections	Instructional Resources	Technology & 21st C Skills Integration (Specify)	NJSLS w/ CPI Reference	Evaluation/ Assessment:
1. Using robots in manufacturing 2. Evaluating potential uses for robots 3. Preparing and implementation plan 4. Fully automated factories 5. Robots outside the factory 6. Artificial Intelligence and Expert Systems 7. Future of Robotics.	The definition of the following terms: Expert systems serbots microbots telerobotics	Identify current applications of service robots. Explain the impact of artificial intelligence on the field of robotics. Summarize the difference between expert systems and regular computer systems. Describe the impact computer-controlled machinery has on the workforce. Identify working environments that are candidates for robot implementation. List non-economic justifications for investing in robots. business/company Prepare a robot implementation plan dentify current applications of service robots. Explain the impact of artificial intelligence on the field of robotics. Summarize the difference between expert systems and regular computer systems. Describe the impact computer- controlled machinery has on the workforce.	Research : The development of robot arms and mobile robots that are operated by remote control. Construct a remote control robot to perform a specific task using end effectors and other sensors to actively perform a specified task.	**Textbook,** pages 281–290 Review Questions, page 290 Learning Extensions, page 290 Handout Master HM 13-1 AI Research Classifications Lesson LS 13-1 Telerobo Applications LS 13-2 Security Applications	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 -2 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.ST-ET.4	8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	**Formative Assessments:** Chapter 13 Quiz **Unit 10 exam** **Summative Assessment(s)** Final Exam

Unit Modifications for Special Population Students:

Struggling Learners	Gifted and Talented Students (Challenge Activities)	English Language Learners	Learners with an IEP	Learners with a 504
• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org	• Refer to page four in the Parent and Educator Guide to Section 504 to assist in the development of appropriate plans.

CROSS-CONTENT STANDARDS ANALYSIS

Course Title: Introduction to Robotics **Grade:** 9-12

Unit Title:	Visual and Performing Arts	Comp. Health & Physical Ed.	English Language Arts	Mathematics	Science	Social Studies	World Languages	Technology	21st Century Life & Careers
I. Intro to Course / Lab Safety / Careers			NJSLS.ELA-LITERACY.RI.9-10.4			6.2.12.D.2.e		8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4
II. Introduction to Industrial Robotics								8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AR 4 9.3.12.AR.B4 9.3.IT-SUP.2-3 9.3.ST-ET.4
III. Fundamentals of Robotics .			NJSLS.ELA-LITERACY.RI.9-10.4 NJSLS.ELA-LITERACY.RI.11-12.7	CONTENT.HSA.SSE.A.1 CONTENT.HSG.MG.A.1 CONTENT.HSG.MG.A.3	5.1.4.A.2	6.2.8.C.4.c 6.2.12.D.2.e		8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4
IV. Programming the Robot			NJSLS.ELA-LITERACY.RI.11-12.7	CONTENT.HSA.SSE.A.1 CONTENT.HSG.MG.A.3	5.1.4.A.2			8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3

									9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4
V. Industrial Applications				CONTENT.HSG.MG.A.3				8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.ST-ET.4
VI. Power Supplies and Movement Systems			NJSLS.ELA-LITERACY.RI.9-10.4			6.2.12.D.2.e		8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4
VII. Sensing and End of Arm Tooling			NJSLS.ELA-LITERACY.RI.9-10.4			6.2.12.D.2.e		8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AR 4 9.3.12.AR.B4 9.3.IT-SUP.2-3 9.3.ST-ET.4
VIII. Control Systems and Maintenance			NJSLS.ELA-LITERACY.RI.9-10.4 NJSLS.ELA-LITERACY.RI.11-12.7	CONTENT.HSA.SSE.A.1 CONTENT.HSG.MG.A.1 CONTENT.HSG.MG.A.3	5.1.4.A.2	6.2.8.C.4.c 6.2.12.D.2.e		8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4

IX. Mobile Robots, Construction, Programming, & Applications			NJSLS.ELA-LITERACY.RI.11-12.7	CONTENT.HSA.SSE.A.1 CONTENT.HSG.MG.A.3	5.1.4.A.2			8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10 9.3.ST-ET.4
X. Robots in Future of Manufacturing				CONTENT.HSG.MG.A.3				8.2.a.1-3 8.2.b.1-6 8.2.c.1-3	9.3.12.AC-DES.1 – 2 9.3.12. AR – AV.1 – 29.3.12.AR-VIS.1 – 3 9.3.IT-SUP.2-3 9.3.ST-ET.4

Washington Township Public Schools
Department of Student Personnel Services

CURRICULUM MODIFICATION

The regular curriculum is modified for Special Education students enrolled in both self-contained and resource center classes.

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- Variation of output: adapting how a student can respond to instruction
- Variation of size: adapting the number of items the student is expected to complete
- Modifying the content, process or product

Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here.

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