

# ENGINEERING DESIGN – ROBOTICS II

LENGTH OF TIME: Every Day – 1 Semester

GRADE LEVEL: 10-12

## COURSE STANDARDS:

Students will:

1. Solve problems using the Systems Approach to problem solving. (PA Academic Std 3.1a, 3.2d, 3.6b, 3.7a-c; Natl Std 1-13, 16, 19, 20)
2. Make oral presentations to the class using Power Point. (PA Academic Std 3.1a, 3.2d, 3.6b, 3.7a-c; Natl Std 1-13, 16, 19, 20)
3. Create Design briefs using MSPublisher. (PA Academic Std 3.1a, 3.2d, 3.6b, 3.7a-c; Natl Std 1-13, 16, 19, 20)
4. Research Information on Robotics and its application in industry. (PA Academic Std 3.8a-c; Natl Std 1-13, 16, 19, 20)
5. Use professionals in the field as mentors. (PA Academic Std 3.8a-c; Natl Std 1-13, 16, 19, 20)
6. Program the controller for specific tasks. (PA Academic Std 3.1a, 3.2d, 3.6b-c, 3.7a-c; Natl Std 1-13, 16)
7. Use electronics to complete circuits involving motors, speed controllers, relays switches and batteries. (PA Academic Std 3.1a, 3.2d, 3.6b-c, 3.7a-c; Natl Std 1-13, 16)
8. Use the computer aided design program, Inventor, to design prototypes. (PA Academic Std 3.1a, 3.2d, 3.6b, 3.7a, c; Natl Std 1-13, 16)
9. Safely use tools and equipment in the manufacture of prototypes. (PA Academic Std 3.1a, 3.2d, 3.6b-c; 3.7a-c; Natl Std 1-13, 16)
10. Work in teams to design robotic systems, design briefs and presentations. (PA Academic Std 3.1a, 3.2b, 3.6b, 3.7a; Natl Std 1-13, 16)
11. Troubleshoot and correct problems associated with electronics, programming, and pneumatics. (PA Academic Std 3.1a, 3.2d, 3.6b-c, 3.7a-c; Natl Std 1-13, 16)
12. Create brochures that depict electronics, pneumatics, programming, and manufacturing. (PA Academic Std 3.6b, 3.7a-d; Natl Std 1-13, 16, 19)
13. Create spreadsheets for materials and cost analysis of final prototypes. (PA Academic Std 3.1a, 3.2d, 3.7a-d; Natl Std 1-13, 16)
14. Student reads and comprehends information materials to develop understanding and expertise by producing written and oral work. (PA Academic Std 3.1a, 3.2d, 3.6b, 3.7a-c; Natl Std 1-13, 16, 19)
15. Student demonstrates understanding of rules of English in every written, visual and oral piece produced. (Natl Std 1-13, 16, 19)
16. Creates and implements tasks associated with a time line. (PA Academic Std 3.1a, 3.2d, 3.8a-c; Natl Std 1-13, 16, 19)
17. Create a robotics prototype capable of completing a number of designed tasks. (PA Academic Std 3.1a, 3.2d, 3.6b-c, 3.7a-e; Natl Std 1-13, 16, 19)

18. Utilize CAD/CAM techniques in the manufacturing of the prototype.(PA Academic Std 3.1a, 3.2d, 3.6b-c; 3.7a-e; Natl Std 1-13, 16, 19)

#### RELATED PA ACADEMIC STANDARDS FOR SCIENCE AND TECHNOLOGY

- 3.1 Unifying Themes
  - A. Systems
- 3.2 Inquiry and Design
  - D. Problem Solving in Technology
- 3.6 Technology Education
  - B. Information Technology
  - C. Physical Technologies
- 3.7 Technological Devices
  - A. Tools
  - B. Instruments
  - C. Computer Operations
  - D. Computer Software
  - E. Computer Communication Systems
- 3.8 Science, Technology and Human Endeavors
  - A. Constraints
  - B. Meeting Human Needs
  - C. Consequences and Impacts

#### NATIONAL TECHNOLOGY STANDARDS

The students will develop an understanding of:

1. The Characteristics and Scope of Technology.
2. The Core Concepts of Technology.
3. The Relationships among Technologies and the connections between technology and other fields.
4. The cultural, social, economic, and political effects of technology.
5. The effects of technology on the environment.
6. The role of society in the development of and use of technology.
7. The influence of technology on history.
8. The Attributes of design.
9. Engineering Design.
10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
11. Apply the design process.
12. Use and maintain technological products and systems.
13. Assessing the impact of products and systems.
14. Medical technologies.
15. Agricultural and relate Biotechnologies.
16. Energy and Power Technologies.
17. Information and Communication Technologies.
18. Transportation Technologies.
19. Manufacturing Technologies.

## 20. Construction Technologies.

### PERFORMANCE ASSESSMENTS:

Students will demonstrate achievement of the standards by:

1. Identifying the inputs, processes, outputs for each system and by developing the evaluation tool used in the feedback loop of the systems approach. (Course Standard 1)
2. Develop a presentation that follows the design brief and utilizes power point, including digital photography and sound. (Course Standard 2)
3. Create a design brief that includes specific information about brainstorming, problem solving, computer-aided design, manufacturing, controls/electronics, programming, materials, time management, testing and evaluation, construction.(Course Standard 3)
4. Read and critique two articles on the application of Robotics in our society. (Course Standard 4)
5. Utilize engineers and technicians from careers such as robotics, electrical, mechanical, and computer engineers by documenting these encounters in the design brief. (Course Standard 5)
6. Develop, create and apply programming that will control specific systems on the robot. (Course Standard 6)
7. Design circuits that include motors, controllers, speed controllers, switches, pneumatics, relays and batteries that will drive lifts, drive systems, grabbing systems, pulling and climbing systems. (Course Standard 7)
8. Construct drawings of all systems using Autodesk Inventor in the design process. (Course Standard 8)
9. Identifying and demonstrating the safe use of tools, machines and procedures during the production of the prototype. (Course Standard 9)
10. Working with a partner; design and construct a prototype of various Robotic systems that will complete the designated tasks. (Course Standard 10)
11. Testing circuits for voltage, amperage and short circuits. Record the results and use the information in correcting problems and reaching the team output. (Course Standard 11)
12. Design and create a brochure that utilizes digital multimedia techniques that market the electronic pneumatics, programming, and manufacturing systems on the Robotic. (Course Standard 12)
13. Produce spread sheets that demonstrate financial responsibility. (Course Standard 13)
14. Use the Internet to research information on Robotics and implement the information into lifting, grabbing, climbing, and drive systems. (Course Standard 14)
15. Produce a design brief that describes all aspects of the engineering process. (Course Standard 15)
16. Produce a time line and task list that shows time management in the solution to an engineering Robotics problem. (Course Standard 16)
17. Design, construct, and test robotic systems that utilize various manufacturing techniques. (Course Standard 17)
18. Design and manufacture parts on the CNC Router table utilizing the design programs AutoCad, Composer and Artpath. (Course Standard 18)

#### DESCRIPTION OF COURSE:

The course is designed to provide students with a broad background in robotics. Students will explore concepts such as manufacturing, programming, CAD/CAM , electronics, team work, motor control, pneumatics, and communication skills. The students will be given the opportunity to apply all that they learn in the development of the design brief and prototype.

#### TITLES OF UNITS:

1. Intro to Robotics - 2 Days
2. The Design Brief - 3 Days
3. Design – Inventor and Autocad - 1 Week
4. Problem Solving – Systems Approach - 1 Week
5. Physical Design – Integration of Systems - 5.5 Weeks
6. Manufacturing Techniques – Machining Techniques – 5.5 Weeks
7. Programming – The Robot Controller – 1 Week
8. Electronics – Motors and the Control System - 1 Week
9. Pneumatics – 1 Week
10. Presentation - 1 Week

#### SAMPLE INSTRUCTIONAL STRATEGIES:

1. Internet Research
2. Individual Instruction
3. Ongoing assessment
4. Student Mentoring
5. Brainstorming using the Systems Approach
6. Technical Writing
7. Critical Thinking
8. Hands on Activities
9. Journal Keeping
10. Computer Aided Design

#### MATERIALS:

1. Computer Lab
2. Manufacturing Lab
3. Internet
4. Computer Aided Design Software – Inventor, AutoCad, Composer, Artpath
5. MS Office w/Word, Access, Excel and Power Point
6. Scanners
7. Digital Camera
8. Raw materials ie. Aluminum, PVC, Lexan, Wood, Plywood.
9. Reference materials on Electronics, Programming, Pneumatics, Manufacturing and CAD.

#### METHODS OF ASSISTANCE AND ENRICHMENT:

1. Lutron Electronics, Pharmacopia, Custom Finishers and Amplifier Research providing mentoring for the students.

#### PORTFOLIO DEVELOPMENT:

The following items are appropriate for inclusion in their portfolios:

1. Design Brief
2. Photos and video of their prototypes in action.
3. Computer programs that they designed.
4. Power Point presentation.

#### METHODS OF EVALUATION:

At the time the project is given, students receive detailed instructions, along with a rubric.

#### INTEGRATED ACTIVITIES:

1. Concepts
  - ◆ Researching the variety of applications of robots.
  - ◆ Discussing the pros and cons of solving a specific task through robotics.
2. Communication
  - ◆ Computer Aided Design - Visual
  - ◆ MS Publisher - Written
  - ◆ Design Brief - Written
  - ◆ Power Point Presentation - Oral
3. Thinking/Problem Solving
  - ◆ Solving problems using the Systems Approach
  - ◆ Creating testing and evaluation formats/sheets
  - ◆ Analyzing data to solve problems.
  - ◆ Creation of Spread sheets
4. Application of Knowledge
  - ◆ Written Descriptions of Solutions
  - ◆ Construction of Prototypes
  - ◆ Creation of programs that allow the robot to function.
  - ◆ Creation of an Electrical Circuit.
  - ◆ Trouble shooting
5. Interpersonal Skills
  - ◆ Working with a partner to solve engineering problems.
  - ◆ Interviewing professionals.
  - ◆ Utilizing members of the class in the solution of problems.