

**YOSEMITE REGIONAL OCCUPATIONAL PROGRAM
COURSE OUTLINE**

COURSE TITLE: Robotics Engineering I ROP S1 Robotics Engineering I ROP S2

COURSE NUMBER: ROP71501 ROP71502

RECOMMENDED GRADE LEVEL: 11-12

ABILITY LEVEL:

DURATION: 1 year

CREDIT: 10 per year

GRADING FORMAT: Standard 0-4 Grade Points

MEETS GRADUATION REQUIREMENTS: Practical Arts, Elective

REQUIRED FOR GRADUATION: No

CBEDS CODE: 5612

MEETS UC AND CSU ENTRANCE REQUIREMENTS: No – will apply

CREDENTIAL REQUIREMENTS: Teacher must be credentialed in one of the

STEM (Science, Math, Engineering, or Technology) content areas.

REPLACES:

Course Description:

Robotics Engineering Technology explores the interaction of science and technology. The program is designed to interest students in the field of robotics and motivate them to pursue advanced education in science and engineering. Computer programming is emphasized. Using student centered, hands-on, problem based learning model, students work in small groups to design, program, and construct robotic devices used in small class competitions and possibly including competition at NASA's U.S. FIRST. Integrated throughout the course are skills such as communication, interpersonal skills, problem solving, workplace safety, and technology and employment literacy.

Recommended Prerequisites: Algebra, Geometry

Date Aligned with State Standards: December 1, 2010

Board Approved: March 21, 2011

REQUIRED TEXTBOOK (Title, publisher, year):

The Robotics Primer by Maja Mataric, MIT Press, Cambridge, Massachusetts, 2007

INSTRUCTIONAL MATERIALS

REQUIRED TEXT(S):

The Robotics Primer by Maja Mataric, MIT Press Cambridge, Massachusetts, 2007

SUPPLEMENTARY TEXT(S):

RobotC Curriculum for Tetrix and Lego Mindstreams
Tetrix and Lego Mindstreams kits

Course Goals and/or Major Student Outcomes

Students will:

Develop an understanding of the relationship between science and technology.

Demonstrate ability to solve problems and think critically by completing challenging group and individual projects.

Understand the key elements of how the concepts underlying a problem can lead to the design and production of a viable solution.

Apply tools and technologies employed by robotics engineers in the solution of problems.

Participate in project-oriented technology education using engineering applications that reinforce academic core competencies.

Design and build robotic devices.

Document their work, demonstrating principles of mathematics and science applied in the design of their projects.

Address technological literacy through their projects by writing computer programs to control their robots, using conditional statements, loops, variables, timers, and wait states.

Apply appropriate instrumentation including software tools to make measurements.

Identify strengths and limitations of theoretical models.

Identify and learn from unsuccessful outcomes.

Identify and deal with health, safety, and environmental issues related to technological processes.

Work effectively in teams.

Communicate effectively about the laboratory experience in writing and orally.

COURSE OUTLINE

First Semester

1. Team Building

Chapter 2: Where Do Robots Come From?

Chapter 20: Go, Team!

Project Management

Project Planning

Engineering Process

Project Planning Documents: Team Building, Understanding the

Problem, Brainstorming, Planning your Time, Design reviews,

Organizational Matrix Ideas, Recording Progress, Gantt Chart, PERT

Chart

Anchor Standards Information and Communications Technology: 9.2,9.3

Career Readiness: 2, 9

CTE Industry Sector Information and Communications Technology: Software and Systems Development (C) 1.4

2. Safety

Chapter 3: What's In A Robot?

Safety is an Attitude: General Lab Safety, Safety Checklist

TETRIX Safety: Electrical Safety, Power Tools Safety

Safety Tests and Quizzes: Robotics Lab Inspection Sheet, Safety Attitude, General Safety, Safety Checklist

Anchor Standards Information and Communications Technology: 6.3,6.4,6.6,6.10

Career Readiness: 1

3. Build a Lego Robot

Chapter 13: Think Hard, Act Later

Slideshow: REM robot, Touch + Light Attachment, Side Button Attachment

Schematic Reading and Interpretation: LEGO Encoder Attachment, Mantis, REM robot, REM Touch + Light Attachment, REM Ultrasonic Attachment, REM Sound Attachment, REM Gripper Attachment, .../Local Settings/Temporary Internet Files/Content.Outlook/Local Settings/Temporary Internet Files/Local Settings/Temporary Internet Files/Content, IE5/Program Files/Robotics, Academy/ROBOTIC Curriculum TETRIX and LEGO/tetrix setup/documents/mantis_print.html TETRIX Testbed (Part 1), TETRIX Testbed (Part 2)

TETRIX Hardware: Safety: Working with TETRIX, TETRIX

Part Identification, Construction Tips, Structure, Motors, Gears, Wheels, Servos, Pivots, Grippers, Actuators, Using LEGO with TETRIX, Hand Tool Identification

Anchor Standards Engineering and Architecture: 1.0, 2.4, 5.1-5.4, 7.4, 9.7
Career Readiness: 1, 2, 4, 5, 9, 10, 12

4. Begin the Use of an Engineering Notebook

Chapter 12: What's In Your Head

Chapter 4: Arms, Legs, Wheels, and What Really Drives Them

Project Management: Keeping an Engineering Journal, Engineering Process Reference, Engineering Definitions

Anchor Standards Engineering and Architecture: 2.5

Career Readiness: 1, 2, 5

CTE Industry Sector Information and Communication Technologies: Information Support and Services Pathway (A)1.3, Software and Systems Development Pathway (C)1.6; Engineering and Architecture Industry Sector; Engineering Technology (B) 10.1-10.3, 11.1, Engineering Design (C)1.1, 2.3, 11.1, 11.2

5. Download Firmware: NXT Hardware, Using the NXT, NXT Sensors, Parts Identification, TECHNIC Hardware Primer

Chapter 5: Move It!

Chapter 6: Grasping At Straws

NXT Setup: Downloading Firmware to the robot, Downloading a Sample program to the robot, REM Building Instructions, Running a Program

TETRIX Setup: TETRIX Testbed, Testbed Instructions (Part 1), Testbed Instructions (Part 2), Mantis Building Instructions

Quizzes: NXT Hardware, Using the NXT, NXT Sensors, Parts Identification, TECHNIC Hardware Primer

Anchor Standards Information and Communications Technology 4.1

Career Readiness: 1, 4

CTE Industry Sector Information and Communication Technologies: Information Support and Services Pathway (A): 2.3, 6.2-6.4, Networking (B)2.1-2.3, 3.5-3.6,

6. Introduction to Programming

Chapter 7: What's Going On

Thinking about programming: Behaviors, Flowcharts & Pseudocode, Programmer and the Machine, Planning and Behaviors

ROBOTC Syntax: Whitespace, Comments, Reserved Words, ROBOTC Rules (Part 1)

ROBOTC Rules (Part 2), ROBOTC Interface, ROBOTC 2.0 Update

Anchor Standards Information and Communications Technology 1.0, 2.4-2.7, 5.1-5.9

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies: Information Support and Services Pathway (A)2.3, 6.2-6.4, Software and Systems Development Pathway (C) 4.6, 4.9, 4.11, 5.4, 5.6, 9.1-9.5

7. Learn about movement

Chapter 10: Stay In Control

Moving Forward: Programming Dissection, Timing

Speed and Direction: Half Motor Power, Turn and Reverse

Improved Movement: Principles of PID, PID Control, Synchronized Motors, Target Distances

TETRIX Movement: Moving Forward, Motors and Sensors, TETRIX Speed and Direction, Intro to Servo Motors, using Servo Motors, Debugging Servos

Anchor Standards Engineering and Agriculture 1.0, 2.4, 2.5, 5.1-5.4, 9.7; 1.0, Information and Communications Technology 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies; Software and Systems Development Pathway (C) 4.6, 4.9, 4.11, 5.4, 5.6, 9.1-9.5; Industry Sector Engineering and Architecture; Engineering Technology (B)4.1, 4.2

8. First Challenge is issued.

Chapter 11: The Building Blocks of Control

Anchor Standard Engineering and Architecture Industry Sector 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies Industry 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies; Information Support and Services Pathway (A)8.1, 8.5; Software and Systems Development Pathway (C) 4.6,, 4.9, 4.11, 5.4, 5.6, 9.1-9.5; Engineering and Architecture Industry; Engineering Technology Pathway (B)6.1-6.3, 6.6, 6.7, 7.3, 7.4

9. Each student designs his or her first program to meet the Challenge

Chapter 16: Think the Way You Act

Chapter 17: Making Your Robot Behave

Movement is discussed among team members

Measurements taken of the field

A design plan is created

Anchor Standards Engineering and Architecture Industry Sector; 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies Industry Sector 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies; Information Support and Services Pathway (A)8.1, 8.5, Software and Systems Development Pathway (C)4.6, 4.9, 4.11, 5.4, 5.6, 9.1-9.5; Engineering and Architecture Industry; Engineering Technology Pathway (B) 6.1-6.3, 6.6, 6.7, 7.3, 7.4, 8.1-8.6, Engineering Design (C) 2.3; Manufacturing and Production Development Industry Sector; Product Innovation and Design Pathway (D)3.1, 3.2, 4.2, 4.3, 5.2, 6.2

10. Discuss alterations needed to meet the challenge.

Chapter 18: When the Unexpected Happens

Anchor Standards Engineering and Architecture Industry Sector 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies Industry Sector 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies; Information Support and Services Pathway (A) 8.1, 8.5, Software and Systems Development Pathway (C) 4.6, 4.9, 4.11, 5.4, 5.6, 9.1-9.5; Engineering and Architecture Industry; Engineering Technology Pathway (B) 6.1-6.3, 6.6, 6.7, 7.3, 7.4, 8.1-8.6; Manufacturing and Production Development Industry Sector; Product Innovation and Design Pathway (D) 6.3, 7.3

End of First Semester

Second Semester

1.1 The following is a list of the progressively more difficult challenges.

Chapter 19: Going Places

Mini-Challenges: Auto Attendance Challenge, Bull Ring Challenge, Can Bot Challenge, Firefly Challenge (Level 1), Firefly Challenge (Level 2), Horseshoe Challenge, Line Painter Challenge, Line Runner Challenge (Level 1), Line Runner Challenge (Level 2), Minefield Challenge (Level 1), Minefield Challenge (Level 2), Minesweeper Challenge, MouseBot Challenge, PipeBot Challenge (Level 1), PipeBot Challenge (Level 2), Robo-Slalom Challenge, Robo 500 Challenge (Level 1), Robo 500 Challenge (Level 2), Robo 500 Challenge (Level 3), Robo 500 Challenge (Level 4), Robocci Challenge (Level 1), Robocci Challenge (Level 2), RoboMower Challenge (Level 1), RoboMower Challenge (Level 2), Sumo-Bot Challenge, Table Bot Challenge (Level 1), Table Bot Challenge (Level 2).

Anchor Standards Engineering and Architecture; 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Industry Sector Information and Communication Technologies; Information Support and Services Pathway (A) 8.1, 8.5, Software and Systems Development Pathway (C) 4.6, 4.9, 4.11, 5.4, 5.6, C9.1-9.5; Engineering and Architecture Industry; Engineering Technology Pathway (B) 6.1-6.3, 6.6, 6.7, 7.3, 7.4, 8.1-8.6, Engineering Design Pathway (C) 11.1; Manufacturing and Production Development (D) 3.1, 3.2, 4.2, 4.3, 5.2, 6.2, 6.3, 7.3

Engineering Mini-Challenges: Driving Straight, Remote Control Basics, Remote Control Buttons, Remote Control Turn button, Sentry Simulation (Level 1), Sentry Simulation (Level 2), Sentry Simulation (Level 3), Synching Motors, Turning, Turning with Encoder, Using Servos, Waite States Power Level
12. Add sensors to the robot and program to meet challenges with sensor issues.

Chapter 8: Switch On the Light

Chapter 9: Sonars, Lasers, and Cameras

Wall Detection (Touch): Touch vs. Timing, Configuring Sensors, The While Loop, Putting it Together, Wall Detection (Sonar), A Sonic Sojourn

Forward for Distance: Forward for Distance, Advanced Target Distances (Pt. 1), Advanced Target Distances (Pt. 2), Boolean Logic (Pt. 1), Boolean Logic (Pt. 2)

Forward Until Dark: The Light Sensor, Thresholds 201, Wait for Dark

Line Tracking: Line Tracking (Basic), Line Tracking (Better), Line Tracking (Timer), Line Tracking (Rotation, Part 1), Line Tracking (Rotation, Part 2)

Volume and Speed: Values and Assignments (Part 1), Values and Assignments (Part 2)

TETRIX Sensing: TETRIX Controller Overview, TETRIX Encoders – Moving Forward, TETRIX Encoders – nMotorEncoder, TETRIX

Encoders – Encoder Targets (Pt. 1), TETRIX Encoders – Encoder Targets (Pt. 2), LEGO Motors as Encoders (Pt. 1), LEGO Motors as Encoders (Pt. 2), HiTechnic IR Seeker (Pt. 1), HiTechnic IR Seeker (Pt. 2).

Wall Detection (Touch): Schematic reading of Touch + Light Instructions, Sense Plan Act, While Loops, Boolean Logic

Wall Detection (Ultrasonic): Thresholds, Printable Ultrasonic schematics, Random Number

Forward for Distance: Encoders

Forward Until Dark: Schematic reading of Touch + Light Instructions, Thresholds, Random Numbers

Line Tracking: Schematic reading of Touch + Light Instructions, If-Else Statement, Switch-Case Statement, Timers

Volume and Speed: Sound Schematics

TETRIX Sensing: Power Level Investigation

Anchor Standards Engineering and Architecture Industry 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Industry 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Information and Communication Technology Industry; Information Support and Services Pathway (A)8.1, 8.5, Software and Systems Development Pathway (C)4.6, 4.9, 4.11, 5.4, 5.6, 9.1-9.5; Engineering and Architecture Industry, Engineering Technology Pathway (B) 6.1-6.3, 6.6, 6.7, 7.3, 7.4, 8.1-8.6; Manufacturing and Production Development, Product Innovation and Design Pathway (D)3.1, 3.2, 4.2, 4.3, 5.2, 6.2, 6.3, 7.3

13. Build a more complex Robot chassis using the Tetrix kits.

Chapter 15: Think and Act Separately, in Parallel

The objectives of the Mechanical Design module are for all students to:

Understand and apply concepts of load, force, acceleration, and work.

Solve problems involving wheel, gears, pulley and cams, incline planes, levers.

Use valid mathematics and scientific concepts to solve problems involving screws and springs.

Design and building a complex machine using elementary mechanical components.

Knowledge and laboratory experience acquired through the construction of complex mechanisms.

Anchor Standards Engineering and Architecture Industry 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies Industry 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Information and Communication Technology Industry; Information Support and Services Pathway (A)8.1, 8.5, Networking Pathway (B)2.2, Engineering and Architecture Industry, Engineering Design Pathway (B)3.1-3.4, 6.1-6.3, 6.6, 6.7, 7.3, 7.4, 8.1-8.6, Software and Systems Development Pathway (C) 2.3, 11.2; Manufacturing and Product Design Product Innovation and Design Pathway (D)3.1, 3.2, 4.2, 4.3, 5.2, 6.2, 6.3, 7.3

14. Joystick controls:

Chapter 21: Things Keep Getting Better

Chapter 22: Where to Next?

Remote Control Basics: How Remote Control Communication Works, Using Remote Control, Improving Remote Control, Using Buttons, Install Joystick Controller, Gripper Building Instructions.

Anchor Standards Engineering and Architecture 1.0, 2.4, 2.5, 5.1-5.4, 9.7; Information and Communication Technologies 1.0, 2.4-2.7, 4.1, 5.1-5.9, 6.3, 6.6

Career Readiness: 1, 2, 4, 5, 9, 10, 12

CTE Information and Communication Technologies, Information Support and Services Pathway (A)2.3, Networking Pathway (B)2.1, 2.3, 3.6

MODESTO CITY SCHOOLS
TEXTBOOK ADOPTION

NAME OF BOOK: The Robotics Primer

AUTHOR(S): Maja Mataric

PUBLISHER: MIT Press Cambridge, Massachusetts

COPYRIGHT DATE: 2007

ISBN #: 978-0-262-63354-3

PRICE: \$32.00

DEPARTMENT: ROP

CLASS: Robotics Engineering I ROP

GENERAL DESCRIPTION:

A well written, easy to understand introduction to basic robotics programming.

ASSURANCE OF SOCIAL APPROPRIATENESS: The selection committee has determined that the materials comply with the State of California Standards for Evaluation of Instructional Materials with Respect to Social Content.

APPROVED BY:

Selection Committee:

Dr. Liliana Lazo and Heidi Pagani selected this text based on the recommendation of UC Merced Professor of Robotics Engineering Dr. Sefan Carpin along with their own favorable opinion after reading the text.

Curriculum Area Chairperson Thor Harrison
Director, Educational Services, 7-12