Prepared by the Department of Engineering Sciences & Applied Technology
Date of Departmental Approval: January 11, 2017
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1. **Course Number:** ENR103 / ENR103L
   Course Title: Introduction to Robotics / Introduction to Robotics Laboratory

2. **Description:** Students work in teams to design, build, program, and test increasingly complex electro-mechanical robots. The course teaches how robots move (locomotion and kinematics), how they sense (perception), and how they reason about their environment (planning). Lecture information is tied to lab experiments and sessions. Students are exposed to robotics related career options in the manufacturing, service, and medical industries. This course does not require any prior engineering background. (3 class hours / 2 laboratory hours)

3. **Student Learning Outcomes** (instructional objectives, intellectual skills)**:**
   Upon successful completion of this course, students are able to do the following.
   - Apply, categorize, and justify the key steps in the robotic engineering analysis and design process.
   - Design, build, program, test, and evaluate robotic systems built from subsystems.
   - Interpret and use basic math skills and concepts, such as proportions and ratios, graphing data, and computation.
   - Differentiate between and appropriately choose scientific concepts of speed and power, motion and stability, and forces and interactions in designing robotic solutions.
   - Evaluate and select the needed math and science principles to create robotic devices that measure distance and speed, move without using wheels, maximize power to move up an incline, and move and turn to create regular polygons.
   - Formulate an experiment that highlights the importance of using sensors to control robotic behavior and be able to measure, graph, analyze, and interpret sensor data.
   - Create (design and program) robotic systems that move, pick, and/or place objects, simulate manufacturing, sort on color and/or shape, and communicate their location.
   - Apply concepts of patterns, ratios to describe proportional relationships, structure and function, and logical thinking to construct simple and complex machines.
   - Plan and manage activities to develop a solution or complete a project. Test and evaluate a robotic design against a set of requirements.
   - Perform data analysis to test a robotic system, gather data, and use that evidence to engineer system optimizations and improvements.
   - Understand the role of troubleshooting, invention and innovation, and experimentation in problem solving robotic devices.
   - Use a calculator or computer as a tool in solving a wide variety of problems.
   - Demonstrate and practice laboratory etiquette.
   - Evaluate the credibility of measurements from a variety of laboratory devices and instruments.
   - Use word processing, graphics, and spreadsheet software to prepare and present designs and laboratory reports.
   - Argue why robots do not need to be as cognitive as humans in order to be useful in addressing global issues.
   - Distinguish between robot fiction and current state reality of robotic devices and their assimilation into society.
   - Assess the impact that robotic technologies are having on current sustainability and environmental issues.
   - Argue why the robotic engineer is a team worker who needs strong skills in problem solving and communication.
   - Exhibit an understanding of professional ethics and the application to real-life situations involving the use of robotic technology.
   - Be able to debate the impact robotic engineering and robotic deployment has had on the modern world. Emphasis on today's manufacturing, service, and medical industries.
   - Compare and contrast the roles and responsibilities of the most common robotic disciplines.

4. **Credits:** 4 credits

5. **Satisfies General Education Requirement:** Interdisciplinary Studies/General Education

6. **Prerequisites:** MAT035 (Algebra for Non-STEM) or MAT041 (Elementary Algebra for STEM), ENL108 (Critical Reading & Thinking) or satisfactory basic skills assessment scores

7. **Semesters Offered:** Fall, Spring

8. **Suggested General Guidelines for Evaluation:** The course grade will be based on homework assignments; class work and participation; one-hour exam(s); laboratory work and reports; and a final examination. Specific course grading procedures and make-up policies are detailed in a student handout.

9. **General Topical Outline:**

	Subject Area	**Lecture Topics**
1	What Is a Robot and What Do They Do?	• Overview of Robotics • Review of EV3 Robot (EV3 Core Robot Kit and Educator Software) • Programming • Data Logging
2	Working as Engineers	• Understand & learn the Engineering Process; • Learn that engineers design to satisfy a need; • Put into practice teamwork and communication skills such as listening to others and justifying decisions based on evidence; • Build a robot that can move forward 1 m; • Understand that the linear distance of a motorized, wheeled vehicle can be calculated; • Write a program that calculates and displays the actual distance the robot moves.
3	Working as Engineers Continued	• Build a robot that can move forward; • Understand that the linear distance of a motorized, wheeled vehicle can be calculated; • Learn that average speed can be calculated; • Write a program that calculates and displays the average speed.
4	Make It Move Without Wheels	• Build a robot that can move forward using some mechanism other than wheels; • Write a program that makes robot move at least 30 cm • Become familiar with the importance of balance (center of mass) in a structure.
5	Using Sensors (basic control)	• Learn that sensors measure physical phenomena such as angle of displacement, color, percentage of reflected light, distance from an object, and whether a button is pressed or not pressed; • Design and build a robot that uses a sensor; • Write a program using sensor data to control the EV3 Brick Display or Brick Status Lights.
6	More Using Sensors (feedback control)	• Learn that sensors provide feedback to a system; • Realize that robots use sensors to provide information about the environment in a similar way that we and other living beings use senses to affect behavior; • Build a robot with sensors that simulates a real-life set of activities; • Write a program using feedback to control a motor to make a robot react to its environment.
7	Even More Using Sensors (Real time graphing)	• Understand that sensors measure physical phenomena; Sense light and dark conditions in the environment; Respond with different behaviors to each condition; • Understand that sensor data can be viewed in real time or uploaded into a graph environment; • Understand that a graph program uses sensor data input

		to control outputs such as sounds, images, text and motor movement; • Write a program that uses sensor data to control an output based on changes in light sensor input. Graphs the robot's behavior and environmental conditions.
8	Systems Thinking	• Become familiar with the language and the conceptual and practical thinking about a robot as a larger system of subsystems. • Design and build a robotic system that picks up the Cuboid and places it in another location; • Understand that larger systems can be made from smaller systems or subsystems; • Understand that sensor data can control systems using feedback • Understand that pick-and-place robots are examples of production technology; • Write a program to control picking up the Cuboid, moving it and placing it in another location.
9	More Systems Thinking	• Design and build a robotic system that can recognize three colors and sort them into separate locations; • Learn how larger systems can be made from smaller systems or subsystems; • Recognize that sensor data can control systems using feedback; • Understand that robots that sort objects are production technology; • Write a program to control the color sensing and sorting movement.