Subject:	ROBO
Course Number:	120
Descriptive Title:	Underwater Robotics
Division:	Industry and Technology
Department:	Robotics
Course Disciplines:	Electronics and Computer Hardware Technology, Manufacturing Technology
Catalog Description:	This introductory course provides students with a general overview of the underwater robotics industry and its science, design and fabrication. Students will explore the types of underwater vehicles, how they are designed, how robots function in a water environment, and the types of structures and materials used for underwater robotics. Students will also comprehend the pressure hulls and canisters necessary in underwater robots, as well as comprehend buoyancy, stability and ballast, and how it impacts maneuverability in an ocean environment. The curriculum will guide students in understanding the power systems used in underwater robotics, as well as selection criteria involving navigation, control, hydraulics, payloads and operations of underwater robots.
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Eligibility for English 1A/English C1000
Enrollment Limitation:	
Hours Lecture (per week):	4
Hours Laboratory (per week):	0
Outside Study Hours:	8
Total Course Hours:	72
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	
Transfer UC:	Yes
Effective Date:	pending
General Education ECC:	
Term:	
Other:	
CSU GE:	
Term:	

Other:	
IGETC:	
Term:	
Other:	
CalGETC:	
Term:	
Other:	
Student Learning Outcomes:	1. SLO #1 – UNDERWATER ROBOT TYPES AND SENSORS The student will be able to describe the difference between different types of underwater robots, including an ROV and an AUV. Students will also be able to identify the purpose of robots and all related electric & mechanical components. 2. SLO #2 – STRUCTURE AND MATERIALS The student will be able to identify ideal structural aspects of underwater robots and appropriate selection of materials that are compatible with the ocean, including material life-cycle. 3. SLO #3 – UNDERWATER PHYSICS AND ROBOT OPERATIONS By the end of the course, the student will be able to design a prototype underwater robot.
Course Objectives:	1. Define an underwater robot, distinguish between the different types of underwater robots, and identify the applications of underwater robots. 2. Interpret conditions that affect why different types of underwater robots are deployed in various parts of the ocean. 3. Examine and identify the electronic and mechanical components used in underwater robtos, Familirize with the subsystems required to estabish a viable underwater robotic system. 4. Understand concepts and applications for material selection in an underwater environment, and how it impacts moving and maneuvering of an underwater robot. 5. Write up a proposal for an underwater robot, identifying the various components and subsystems, and how it will perform a give task with a specified energy budget. 6. Explain the differences between an ROV and an AUV.

	7. Differentiate the various sensors used in underwater robots, including how they are integrated, under what circumstances they are selected, and how it impacts the energy budget.
Major Topics:	I. UNDERWATER ROBOTICS OVERVIEW (2 hours, Lecture) A. Types of underwater vehicles B. History of undersea vehicles and technologies C. Current underwater vehicles and technologies D. Applications of underwater robots II. UNDERWATER ROBOT DESIGNS (6 hours, Lecture) A. Common design challenges B. Design methodology for underwater vehicles III. UNDERWATER ENVIRONMENT (6 hours, Lecture) A. Physical properties of water B. Water movements C. Plant and animal life in water D. The water column IV. STRUCTURE & MATERIALS (8 hours, Lecture) A. Structural performance criteria B. Design considerations C. Structural shapes D. Structural materials E. Metal corrosion F. Fabrication and assembly V. PRESSURE HULL AND CANISTERS (8 hours, Lecture) A. Pressure B. Forces of submerged objects C. Pressure hull and canister basics D. Calculating pressure-related forces on spheres and cylinders E. Constructing leak-proof openings F. Pressure compensation techniques G. Encapsulation VI.. BUOYANCY, STABILITY AND BALLAST (8 hours, Lecture) A. Floating and sinking parameters B. Optimal buoyancy designs C. Tipping and floating parameters D. Vehicle orientation maneuvering E. Stability F. Ballast Systems VII. MOVING AND MANEUVERING (8 hours, Lecture)

	A. Newton's laws and underwater forces B. Underwater thrust requirements C. Producing thrust D. Electric motors E. Propellers F. Building thrusters G. Thruster placement VIII. POWER SYSTEMS (6 hours, Lecture) A. Energy, power and efficiency B. Realistic vehicle power C. Electricity and electric circuits D. Electric power sources E. Electrical power transmission and distribution F. Circuit design and construction IX. CONTROL AND NAVIGATION (6 hours, Lecture) A. Greater precision movements of robot through tuning and calibration B. Basic robot maneuvers C. Speed control D. Custom navigation via combining series of maneuvers E. Competition and performance evaluation X. CONTROL AND NAVIGATION (6 hours, Lecture) A. Control systems B. Navigation systems C. Advanced control options XI. HYDRAULICS AND PAYLOADS (6 hours, Lecture) A. Hydraulic mechanisms B. Manipulators C. Underwater tasks and tools D. Payload design considerations XII. OPERATIONS (2 hours, Lecture) A. Types of operations B. Operational phases
Total Lecture Hours:	72
Total Laboratory Hours:	0
Total Hours:	72
A.1. Primary Methods of Evaluation (Part 1 - CCN courses only):	n/a

Primary Method of Evaluation:	1) Substantial writing assignments
Typical Assignment Using Primary Method of Evaluation:	Design on paper or with a Computer Aided Design (CAD) program a drawing of a prototype underwater robot. Examine and identify the electronic and mechanical components of an underwater robot. Identify energy budget and constraints based on selection of sensors and mission parameters. Submit design to the instructor for evaluation.
Critical Thinking Assignment 1:	In a two- to three-page report, explain underwater robot sensor selection in context to mission objectives, and list what materials will be used, including why they are compatible for the underwater environment. Submit report to the instructor.
Critical Thinking Assignment 2:	In a two- to three-page report, describe mission types that are possible with underwater robots, including operational times relative to an energy budget. Submit report to the instructor. Design on paper or use a Computer Aided Design (CAD) program to draw a prototype underwater robot, specifying the power source, electrical and mechanical subsystems, and describe why the design and chosen systems fulfill a given mission objective. Submit design to the instructor.
Other Evaluation Methods:	Class Performance, Completion, Homework Problems, Matching Items, Multiple Choice, Presentation, Reading Reports, Term or Other Papers, True/False
If Other:	
Instructional Methods:	Discussion, Guest Speakers, Lecture, Multimedia presentations
If other:	Simulation
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Texts:	Moore, Bohm and Jensen - UNDERWATER ROBOTICS – Marine Advanced Technology Education Center – 2010 – Discipline Standard
Alternative Texts:	
Required Supplementary Readings:	
Other Required Materials:	
Requisite	
Category	
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold	Eligibility for English 1A/English C1000

the requisite skill(s). if applicable	
Requisite course:	**Ability to read a college level robotics textbook.** Summarize, analyze, evaluate, and synthesize college-level texts. **Ability to write college level report.** Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). if applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Joseph Weichman
Date:	10/10/2024
Original Board Approval Date:	03/24/2025
Effective Term:	FA 2025