



## Nautical Science

### CAS NS 223 (3 credits)

#### Course Catalog Description (max. 40 words):

Learn the fundamentals of sailing ship operation, in preparation for direct application at sea. Navigation (piloting, celestial and electronic), weather, engineering systems, safety, and sail theory. Participate as an active member of the ship's crew on an offshore voyage.

**Instructor(s):** Sea Education Association (SEA) Nautical Science Faculty/Captains.

**Location:** SEA campus in Woods Hole, MA, and at sea aboard SEA's sailing school vessel (SSV) *Robert C. Seamans*.

**Prerequisites:** Admission to SEA Semester.

#### Course Philosophy and Approach:

*Sustainability in Polynesian Island Cultures (SPICE)* is an interdisciplinary program that examines the interaction of culture and ecological sustainability. We develop the program around this theme by first establishing a working definition of "sustainability," using the islands on our cruise track as case studies. We address the relationship between people and their environment, and look for ways to measure and assess the impact of agriculture and aquaculture, fishing, the introduction of new species of plants and animals, changing demographics due to migration and European colonization, and the impact of global trading networks. The SPICE program consists of five courses, each with specific academic requirements, although the lines between the disciplines in lectures, discussions and projects are, by design, blurred into an interdisciplinary whole. Discussion of course materials from environmental, historical, cultural, scientific and nautical perspectives will integrate our program themes.

*Nautical Science (NS)* is one of the five courses in the SPICE program. This three-credit course is conducted primarily during the six-week sea component aboard the SSV *Robert C. Seamans*. It is the practical application of topics introduced during the *Nautical Science* class ashore. At sea, students join the ship as active members of the crew, working under the guidance of the vessel's professional staff. They will stand watch on deck, learning and applying principles of ship operations including Polynesian and Western navigation methods, vessel operations, and the principles of sail theory, shiphandling, safety and weather prediction. Under a system of progressive responsibility, students will work in stages towards the ultimate role of Junior Watch Officer (JWO), at which point they will assume direct oversight over the routine tasks of ship operations.

This course consists of 22 hours of mixed lecture/practical skills sessions during a series of nautical science training seminars ashore, and approximately 120 hours of supervised deck watch participation (active learning/laboratory) across ~28 underway days at sea. Several of the activities listed on this syllabus are joint activities integrated with other SPICE courses; weekly



contact hours summarized here and given in the course calendar below reflect only the portion allocated to this *Nautical Science* course.

### Learning Outcomes:

1. Understand and be able to explain the underlying principles and demonstrate the use of analog and electronic navigation instruments, including use of charts, compasses, GPS, radar, and sextants.
2. Proficiently operate the sailing vessel by applying knowledge of sail theory, stability, maneuvering under sail, and sail trim for optimum performance.
3. Understand weather from a mariner's perspective, including the physical foundations of meteorology, observation, forecasting, and the impact of weather on navigational decisions.
4. Effectively communicate and participate as part of a team, in both leadership and supporting roles, to successfully accomplish the ship's mission.

### Evaluation:

Shore Component Assignments & Participation	15%
Sheet Anchor	15%
Steward's Assignments	5%
Nautical Science Skills Proficiency	
• Sea Component Skills Checklists	10%
• Sea Component Deck Practical Exam	15%
Sea Component Watch Standing Evaluations	20%
Sea Component Assignments	20%

### Assignments:

Shore Component Assignments & Participation: While on shore, students will have weekly readings, assignments, lectures, and workshops that introduce them to the fundamental observational, mathematical, and conceptual skills required of a successful and safe mariner. Specifically, students will complete a series of piloting homework assignments, including chart-based navigational problems designed to introduce the nautical chart and develop proficiency in plotting and "piloting", or navigation using terrestrial features, lights, and buoys. Students will also complete a series of problems designed to introduce the tools and calculations of celestial navigation. Knowledge of these fundamentals is necessary preparation for watch standing activities during the sea component.

Sheet Anchor: Integral to student success at sea is their preparation of a *Sheet Anchor*, their own "young sea officers" handbook that will provide an organized, concise summary and



synthesis of their nautical science lecture notes, diagrams, vocabulary lists, illustrations of important concepts, and calculations. This document becomes the students' primary resource during the sea component and a repository of additional observations and knowledge gathered at sea. It will be reviewed at the end of the first shore component, and again at the end of the sea component.

Steward's Assignments: Students will prepare for the culinary experience of their sea component and the food cultures of the Polynesian islands they will visit through a series of short assignments completed onshore. In addition to compiling some favorite or family recipes with which they are familiar, students will also research recipes that are either traditional from one of the islands we will visit or make extensive use of local food ingredients in some way.

Nautical Science Skills Proficiency: During the sea component, students will be required to demonstrate skill proficiency in the safety protocols, ship and sail handling, navigation, engineering and weather procedures. These will be assessed via skills checklists and a deck practical exam at sea once the introductory phases of the sea component are complete.

Sea Component Watch Standing Evaluations: Students' participation in *Nautical Science* watch activities onboard ship will be assessed in on-watch evaluations by SEA Mates and Engineers. Each student is an essential crewmember of the ship at sea. Excellent watch standers follow directions, work effectively as part of the watch team, show independence, demonstrate good judgment and leadership, and are a supportive, helpful, and reliable shipmate. Teamwork, management, and leadership are essential skills of a successful watch stander; and a student's attitude and participation directly affects the physical progress of the voyage and safety of the ship.

Sea Component Assignments: At sea, students will complete a series of practical assignments documenting their work during deck watch. These will include exercises and summary reports on coastal piloting, celestial navigation, engineering systems diagrams, and routine analyses of weather, route information, and ship status.

Knots: While there is a host of useful and decorative knots, a mariner is well-served by four knots. Students should be able to tie those four with their eyes closed. One of these knots is assigned during each week of the shore component (see course calendar below), with the goal of each student learning to proficiently tie all the assigned knots. Students will be tested on these knots upon their arrival at the ship.

### **Expectations and Requirements:**

- Punctual attendance is required at every class meeting.
- Active participation in class discussion is expected.
- Late assignment submissions are not accepted.
- The policy on academic accuracy, quoted below, will be strictly followed in this class.

The papers that you submit in this course are expected to be ***your original work***. You must take care to distinguish your own ideas and knowledge from wording or substantive information that you derive from one of your sources. The term

“sources” includes not only published primary and secondary material, but also information and opinions gained directly from other people and text that you cut and paste from any site on the Internet.

***The responsibility for learning the proper forms of citation lies with you.***

Quotations must be placed properly within quotation marks and must be cited fully. In addition, all paraphrased material must be acknowledged completely. Whenever ideas or facts are derived from your reading and research, the sources must be indicated. (Harvard *Handbook for Students*, 305)

- Considerations for use of internet sources:

As you browse websites, assess their usefulness very critically. Who posted the information and why? Can you trust them to be correct? Authoritative? Unbiased? (It’s okay to use a biased source as long as you incorporate it knowingly and transparently into your own work.) Keep track of good sources that might be useful for subsequent assignments, and annotate in your bibliography any sites you cite. Your annotation should include the name of the author or organization originating any material that you reference. If you can’t identify the source, don’t use it!

**Readings:**

Bowditch, Nathaniel. *The American Practical Navigator*, 3<sup>rd</sup> Edition. Paradise Cay Publications, 2002

Chase, Carl. *An Introduction to Nautical Science*, Norton, 1991

Cutler, Thomas. *Dutton’s Nautical Navigation*, 15<sup>th</sup> Edition. Naval Institute Press, 2003

Evans, Jeff. Traditional Polynesian Navigation article.

Rey, Hans Augusto. *The Stars: A New Way to See Them*, 2<sup>nd</sup> Edition. Houghton Mifflin Harcourt Company, 2008

Sea Education Association. “Organization & Operations Manual for the Sea Component”

Sea Education Association. “Sea Component Packing List”

**Course Calendar:**

Topic	Readings/Assignments Due
<b><i>Week 1 (5 Hours) – on shore at SEA campus in Woods Hole Knot: Reef Knot</i></b>	
Introduction to SPICE and Nautical Science (NS): Projects & Course Expectations  Lecture/Discussion Topics: <ul style="list-style-type: none"> <li>• The Mariner’s Earth &amp; Introduction to Charts</li> <li>• Cruise Track Introduction</li> </ul>	<b><i>Readings:</i></b> Chase (1991): Chpt. 9 Cutler (2003): Dutton’s, Chpt. 2, Sec. 201-205, 207-210; Chpt. 5, Sec. 501-508, 523-536.  <b><i>1<sup>st</sup> Steward’s Assignment due this week</i></b>

<b>Week 2 (6 Hours) – on shore at SEA campus in Woods Hole</b>	
<b>Knot: Bowline</b>	
<p>Lecture/Discussion Topics:</p> <ul style="list-style-type: none"> <li>• The Navigator’s Methods</li> <li>• Life at Sea</li> </ul> <p>Piloting Workshop</p> <p>Field Trip: Port of New Bedford &amp; Whaling Museum</p>	<p><b>Readings:</b></p> <p>Chase (1991): Chpts. 8 &amp; 10</p> <p>Cutler (2003): Dutton’s, Chpt. 1; Chpt. 8, Sec. 801-807; Chpt. 11, Sec. 1101-1109.</p> <p>Sea Component Packing List</p>
<b>Week 3 (7 Hours) – on shore at SEA campus in Woods Hole</b>	
<b>Knot: Round turn and 2 half hitches</b>	
<p>Lecture/Discussion Topics:</p> <ul style="list-style-type: none"> <li>• Introduction to Western Celestial Navigation</li> <li>• Polynesian Navigation &amp; Star Compass</li> <li>• Sail Theory &amp; Ship Handling; Stability</li> </ul>	<p><b>Readings:</b></p> <p>Chase (1991): Chpts. 1-4, 11, 13, 14</p> <p>Ray (2008): The Stars, part 4.</p> <p>Evans, Traditional Polynesian Navigation</p>
<b>Week 4 (4 Hours) – on shore at SEA campus in Woods Hole</b>	
<b>Knot: Rolling Hitch</b>	
<p>Lecture/Discussion Topics:</p> <ul style="list-style-type: none"> <li>• Weather for the Mariner</li> <li>• Safety at Sea</li> </ul>	<p><b>Readings:</b></p> <p>Bowditch (2002 ): Chpt. 34</p> <p>SEA ‘Organization &amp; Operations Manual for the Sea Component’</p> <p><b>Piloting Homework due this week</b></p> <p><b>2<sup>nd</sup> Steward’s Assignment due this week</b></p> <p><b>Sheet Anchor review</b></p>
<b>Week 5 and 6 (40 Hours) – at sea between island visits</b>	
<p>Deck Watch standing I: Introductory Phase</p> <ul style="list-style-type: none"> <li>• Shipboard orientation</li> <li>• Safety and emergency management</li> <li>• Departmental training: Seamanship and sail handling; Weather observation; Navigation; Food service and sanitation</li> <li>• Initial watch standing experiences</li> </ul>	<p><b>1<sup>st</sup> Deck Skills Checklist</b></p> <p><b>At-sea assignments (see description above)</b></p> <p><b>On-watch evaluation</b></p>
<b>Week 7 and 8 (40 Hours) – at sea between island visits</b>	
<p>Deck Watch standing II: Apprentice Phase</p> <ul style="list-style-type: none"> <li>• Task management and delegation</li> <li>• Shadow profession crew as apprentice</li> <li>• Continued watch standing experiences</li> </ul>	<p><b>2<sup>nd</sup> Deck Skills Checklist</b></p> <p><b>At-sea assignments (see description above)</b></p> <p><b>On-watch evaluation</b></p>

<b>Week 9 and 10 (40 Hours) – at sea between island visits</b>	
<p>Deck Watch standing III: Junior Watch Officer (JWO) Phase</p> <ul style="list-style-type: none"> <li>• Continued watch standing experiences</li> <li>• Advanced training in practical ship evolutions</li> <li>• Student opportunities to assume direct oversight of ship's operations as JWO</li> </ul>	<p><b><i>At-sea assignments (see description above)</i></b></p> <p><b><i>Deck Practical Exam</i></b></p> <p><b><i>On-watch evaluation</i></b></p> <p><b><i>Sheet Anchor review</i></b></p>