



## **Nautical Science (NS)**

### **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

**Location:** On shore in San Diego, CA, and at sea aboard SEA sailing school vessel.

**Prerequisites:** Admission to the SEA Semester.

#### **Course Philosophy and Approach:**

*Nautical Science* is a three-credit course conducted primarily during the six-week sea component aboard the *SSV Robert C. Seamans*. While ashore, students are introduced to topics necessary for them to join the ship as active members of the crew. Once at sea, students will work under the guidance of the vessel's professional staff to build upon the fundamentals taught ashore. Aboard ship, students will stand watch, learning and applying principles of ship operations including terrestrial and offshore navigation methods, vessel operations, and principles of sail theory, ship stability, safety and weather prediction. Under a system of progressive responsibility, trainees will work in stages towards the ultimate role of Junior Watch Officer (JWO), at which point they will assume direct oversight of ship operations.

This course consists of 18 hours of mixed lecture/practical skills sessions during a series of nautical science training seminars ashore, and approximately 120 hours of supervised watchstanding time in the deck and engineering departments while at sea.

#### **Learning Outcomes:**

1. Become proficient with the processes and underlying principles of analog and electronic navigation, including use of charts, compasses, GPS, Radar, and celestial instruments.
2. Understand weather from a mariner's perspective, including the physical foundations of meteorology, observation, forecasting, and the impact of weather on navigational decisions.
3. Learn the principles of sailing ship operation, including sail theory, stability, maneuvering under sail, and sail trim for optimum performance.
4. Become proficient operators of ship's engineering systems, including diesel engines, AC and DC electrical circuits, pumps, tankage, and refrigeration.
5. Develop leadership and communication skills through active experience in settings with true consequences.



6. Develop skills in the use of ship's safety equipment and procedures, including lifesaving, firefighting, and rescue gear. Understand the effective development of plans and contingencies for emergency management.

**Evaluation:**

Onshore:

Nautical Science Training Seminars

- Piloting Workbook Exercises 5%
- Celestial Workbook Exercises 5%
- Sheet Anchor 10%

At sea:

Watch standing 30%

Nautical Science Skills Proficiency 10%

At Sea Assignments

- Piloting, Celestial, Engineering, and Weather exercises and reports 40%

**Assignments:**

Nautical Science Training Seminars: While on shore, students will have readings, assignments, lectures, and project seminars that introduce them to the fundamental observational, mathematical, and conceptual skills required of a successful and safe mariner. Specifically, students will complete exercises in a *Piloting Workbook*, a series of 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 exercises in a *Celestial Workbook*, 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. Integral to student success at sea is the preparation of their *Sheet Anchor*, an organized, concise summary and synthesis of their nautical science lecture notes, diagrams, 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.

At Sea Watch Standing: 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.



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 at sea once the introductory phase of the sea component is complete.

At Sea 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.

### **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:**

Adkins, Jan. The Craft of Sail: A Primer of Sailing. St. Martins Press, 1994

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

Cutler, Thomas. Duttons Nautical Navigation, 15<sup>th</sup> ed. Naval Institute Press, 2003



LaDage, John, & Lee Van Gemert. Stability and Trim for the Ship's Officer. Cornell Maritime, 1979

SEA (Various) "Organization & Operations Manual for the Sea Component"

United States Coast Guard (USGS). Navigation Rules: International and Inland. Paradise Key, 2013

**Course Calendar:**

Topic	Readings/Assignments Due
<b>Week 1 (9 Hours) – on shore in San Diego, CA</b>	
<p>The Mariner's Earth</p> <ul style="list-style-type: none"> <li>• An introduction to nautical charts</li> <li>• Aids to navigation</li> <li>• The global coordinate system</li> </ul> <p>Piloting and Inshore Navigation</p> <ul style="list-style-type: none"> <li>• The compass</li> <li>• Lines of position</li> <li>• Fixes, ETA</li> <li>• Currents</li> <li>• Electronic navigation</li> </ul> <p>An Introduction to Sailing</p> <ul style="list-style-type: none"> <li>• Sails and rigging</li> <li>• Sail Theory</li> <li>• Shiphandling under sail</li> <li>• Stability</li> </ul>	<p><b>Readings:</b></p> <p>Chase (1991): Chapters 2-4, 8-10            Cutler (2003): Chapters 4-5            Adkins (1994): pp. 10-36            LaDage &amp; Van Gemert (1979): Chapter 1</p> <p><b>Piloting Workbook Exercises due.</b></p>
<b>Week 2 (9 Hours) – on shore in San Diego, CA</b>	
<p>An Introduction to Celestial Navigation</p> <ul style="list-style-type: none"> <li>• Celestial observations</li> <li>• Time and the Nautical Almanac Local Apparent Noon (LAN)</li> <li>• Plotting celestial data</li> <li>• The celestial triangle</li> </ul> <p>Watchkeeping and Safety at SEA</p> <ul style="list-style-type: none"> <li>• Rules of the Road</li> </ul>	<p><b>Readings:</b></p> <p>Chase (1991): Chapters 5, 11-13, 15            USCG (2013): Navigation Rules            SEA -"Organizational and Operations Manual for the Sea Component"</p> <p><b>Celestial Workbook Exercises due.</b></p>



<ul style="list-style-type: none"> <li>• Bridge resource management</li> <li>• Emergency preparedness</li> </ul> <p>Life at Sea</p> <ul style="list-style-type: none"> <li>• Watches and schedules</li> <li>• Staff roles and responsibilities</li> </ul>	
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<b><i>Weeks 3 and 4 (40 hours) – at sea</i></b>	
<p>Deck Watchstanding 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><i>1<sup>st</sup> Deck Skills Checklist</i></b>  <b><i>At-sea assignments (see description above)</i></b>  <b><i>On-watch evaluation</i></b></p>
<b><i>Weeks 5 and 6 (40 hours) – at sea</i></b>	
<p>Deck Watch standing II: Apprentice Phase</p> <ul style="list-style-type: none"> <li>• Advanced training in practical ship evolutions, engineering systems training</li> <li>• Task management and delegation</li> <li>• Each student shadows professional crew leaders as apprentice</li> <li>• Continued watch standing experiences</li> </ul>	<p><b><i>2<sup>nd</sup> Deck Skills Checklist</i></b>  <b><i>Deck Practical</i></b>  <b><i>At-sea assignments (see description above)</i></b>  <b><i>On-watch evaluation</i></b></p>
<b><i>Weeks 7 and 8 (40 hours) – at sea</i></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>• Each student assumes direct oversight of ship’s operations during opportunities to serve as JWO.</li> </ul>	<p><b><i>At-sea assignments (see description above)</i></b>  <b><i>On-watch evaluation</i></b></p>



SEA Semester®: SEA Summer Session