

## **NAUT 001bx: Deepwater Cruising**

Watch Captain Level: 2 academic (semester) units

### General Information

Prerequisite required: Deepwater Cruising: NAUT 001ax or equivalent knowledge

Instructors: Capt. Ron Remsburg, Capt. Noah Pepper

Text: The Annapolis Book of Seamanship, J. Rousmaniere

Videos: Sailboat Navigation; Heavy Weather Sailing

Charts: 1210TR Martha's Vineyard to Block Island (required)

18746 Catalina Channel (optional)

18751 Los Angeles Harbor (optional)

Office: PED 104 5:30-6:45pm Weds. or by appointment

Phone (213) 821-1261

Website: [www.USC.edu/sppd/naut](http://www.USC.edu/sppd/naut)

Grading Policy: Nautical Science classes include class lectures, dockside demonstration, voyages, and a review session at semester end. It is highly recommended that students attend all four events, as they contribute to the academic concepts and skills tested on the final exam, which is the 100% basis of the course grade. The final exam covers seamanship skills and academic navigation chart work, 50% each area, and is administered according to the University published final exam schedule. Students who sign up for an event and do not attend without making prior arrangements are subject to possible grade reduction.

Vessels used: 51' traditional sailing schooner; 36' modern sloop; small 2 person vessels; 120' square rigged brigantine

Meeting Periods: 30 classroom lecture hours  
Practical aboard: 102 hours  
Volunteer practical time to serve as crew in NAUT 001ax voyages if crew openings are available

### Course Syllabus

#### Seamanship Theory

- I. Advanced hull nomenclature and design
  - A. Basic kinds of hull design
  - B. Hull measurement and tonnage
  - C. Displacement and planing hulls
  - D. Theoretical hull speed
  - E. Various keel types
- II. Construction of a sailing vessel  
Building a replica of a Class B Tallship: Bluenose Schooner Atlantias
- III. The plimsoll line  
Displacement and freeboard
- IV. Hull stability
  - A. Center of gravity
  - B. Center of buoyancy
  - C. Righting arm
  - D. The Warship Vasa: A classic example of instability
- V. Sailing Vessel Sails (review)
  - A. Types and parts of sails
  - B. Jib-headed and gaff-headed sails

- C. Kinds of sail cuts: the art of the sailmaker
- VI. Extended sail plan: Cruising/Racing vessels
- VII. Angle of heel and exposed sail area
- VIII. Furling sails
- IX. The problem of being in irons: review
  - A. Cause and avoidance
  - B. How to escape irons in the tack selected
- X. Apparent and true wind: the relation of the wind to a moving vessel
  - A. Speed
  - B. Direction
- XI. Tacking upwind and downwind
- XII. Basic rigging types of sailing vessels and their seagoing characteristics
  - A. Sloop
  - B. Cutter
  - C. Schooner
  - D. Ketch
  - E. Yawl
- XIII. Great sailing ships of the past
  - A. Coastal sailing schooners
  - B. Whalers of 9th Century New England
  - C. Clipper ships "The Wings of Speed"
  - D. German windjammers
  - E. Warships of the line
  - F. Sailing ships of today which return to the past
- XIV. Types of rigging
  - A. Square rigging
  - B. Fore and aft rigging
- XV. Weather and lee helm
  - A. The basis of sail balance and reefing
  - B. Center of lateral resistance
  - C. Center of effort and its calculation
  - D. Vessel balance and seamanship
- XVI. Sailing and heavy weather seamanship
  - A. The basis and structure of waves
  - B. "Heaving to" a sailing vessel
    - 1. Sloop "heave to"
    - 2. Yawl/ketch "heave to"
    - 3. Schooner "heave to"
  - C. Sea anchors and warps
  - D. Hulls in adverse seas
    - 1. Pitch pole
    - 2. Yaw
    - 3. Broach
- XVII. Sail handling in heavy weather
- XVIII. The tiller and the wheel: helmsmanship
- XIX. Advanced boat handling
  - A. Picking up the mooring
  - B. Dock lines and their definition
  - C. Docking under power and sail
  - D. Handling, heaving and securing docklines
  - E. Assisting vessels in heavy seas with lines
- XX. Man Overboard

- A. Returning the vessel to the person
- B. Retrieving the person aboard
- C. Man overboard safety equipment
- XXI. Capsizing and what to do
- XXII. Rule of the road
  - A. Power vessel rules of the road
  - B. Sail vessel rules of the road
  - C. When is a sailboat a powerboat?
  - D. Relative bearings: collision at sea
- XXIII. Legal requirements: U.S. Coast Guard regulations
- XXIV. Ship safety equipment and damage control
- XXV. Anchoring
  - A. Mooring usage in Catalina
  - B. Winter Santa Ana season in Avalon: what to do and where to hide
  - C. Anchoring techniques and considerations
  - D. The use of range perspective and anchoring
  - E. Raising a fouled anchor
  - F. Types of anchors and their purposes
- XXVI. Marlinspike seamanship
  - A. Knot tying
  - B. Whipping
  - C. Simple splices
  - D. Types of line and their function and care
- XXVII. Rigging and fitting systems aboard
- XXVIII. Marine weather
  - A. Basics of the Atmosphere
    - 1. History
    - 2. Composition
    - 3. Water vapor
    - 4. Carbon dioxide
    - 5. Greenhouse gasses
    - 6. Definition of weather
    - 7. Definition of climate
  - B. Temperature and Heat Transfer
    - 1. Temperature scales
    - 2. Atmospheric energy balance
    - 3. Conduction
    - 4. Convection
    - 5. Radiation
    - 6. Controls of temperature
    - 7. Specific heat
  - C. Water in the Atmosphere
    - 1. Phases of water
    - 2. Specific humidity
    - 3. Relative humidity
    - 4. Dew point temperature
    - 5. Measuring humidity at sea
    - 6. Fog types
    - 7. Cloud types
  - D. Air Pressure and Wind
    - 1. Definition of air pressure
    - 2. Measuring air pressure

3. Surface and upper-level pressure
4. Pressure gradient force
5. Coriolis force
6. Friction
7. Buys Ballot's law
8. Vertical motion
9. Large-scale atmospheric motion
10. Trade winds
11. Westerlies
12. Jet streams
13. Wind-driven ocean currents
14. El Niño/Southern Oscillation
15. Sea breezes
16. Santa Ana winds
- E. Fronts and Mid-Latitude Cyclones
  1. Air masses
  2. Identification of fronts
  3. Cold front
  4. Squall line
  5. Warm front
  6. Occluded front
  7. Stages of mid-latitude cyclones
- F. Thunderstorms, Tornadoes, and Waterspouts
  1. Air mass thunderstorms
  2. Lightning
  3. Multi-cell thunderstorm
  4. Supercell thunderstorm
  5. Tornado formation
  6. Tornadic waterspouts
  7. Non-tornadic waterspouts
- G. Tropical Weather and Hurricanes
  1. Ingredients for severe tropical weather
  2. Hurricane requirements
  3. Hurricane structure
  4. Hurricane formation and dissipation
  5. Hurricane locations and seasons
  6. Devastating effects of hurricanes
  7. Notable storms
- H. Basic Weather Forecasting
  1. Forecasting tools
  2. Forecasting methods
  3. Surface charts
  4. Upper-level data
  5. Computer models
- I. Waves, Tides, and Tsunamis
  1. Ocean topography
  2. Astronomical tides
  3. Wave formation
  4. Tsunamis

### **Navigation Theory**

- I. Charts and nautical guides

- A. What is a chart?
- B. Antique navigational charts and instruments
- C. Chart sources and navigational materials
- D. Pilot charts, light lists and sailing directions
- E. Chart catalogues
- F. Scales as applied to charts
- G. Types of chart projections
- H. Soundings found on charts: feet and fathoms
- I. Tides and currents
- II. Chart interpretation and aids to navigation
  - A. Buoys and their significance
  - B. Lighthouses
    - 1. Historical lighthouses
    - 2. Light character, period and range
    - 3. Lighthouse symbolism and its interpretation
  - C. Lateral system: lights and markers in a channel
  - D. Range lights and range markers
- III. Latitude and longitude determination
- IV. Time theory
- V. Measuring distance and the nautical mile in relation to latitude
- VI. Tools of the navigational trade
- VII. What is a knot?
  - A. Methods of determination of speed of a vessel
  - B. Speed, time and distance computations
- VIII. The history of the riddle of longitude determination
- IX. Charts and the magnetic compass
  - A. Variation--magnetic north and true north
  - B. Deviation--shipboard compass influences
- X. Use of the hand bearing compass and Pelorus
- XI. Definition of position by bearing and distance
- XII. Types of navigation--Definition
  - A. Coastal piloting
  - B. Dead reckoning
  - C. Celestial Navigation
  - D. Electronic navigation
    - 1. Radio direction finder (RDF)
    - 2. Depth sounder
    - 3. Introduction to radar navigation
    - 4. Introduction to satellite Navigation
    - 5. GPS
- XIII. Bow and beam bearings
- XIV. Current and drift problems
- XV. Advancing L.O.P.'s and running fixes
- XVI. Correcting compass error: deviation and variation
- XVII. Low visibility navigation

### **Practical Operations Aboard Traditional Schooner or Catalina 36' Sloop**

- 1. Initial dockside 3 bearing fix
- 2. Overall voyage plan/assignment of duties: navigation and deck watches
- 3. Discussion of rules of the road and rights of way: power and sail; dayshapes, traffic lane determination; definition of relative bearings/collision course

4. Use of Coast pilot and Light Lists discussed and demonstrated
5. Nominal ranges of relevant local lights determined from visibility broadcast of marine weather; discussion of nominal and geographic range of lights
6. Underway/seamanship: brief deck orientation with backstay function and reefing demonstration
7. Coastwise day navigation (5 hours); coastwise night navigation (5 hours)
8. Applied running fixes and turn bearings
9. Statement of position demonstration by bearing/distance (use of radar and GPS)
10. Statement of position every hour by latitude and longitude; by bearing/distance (use of the stadimeter)
11. Utilization of relative bearings to determine collision course both day and night
12. Buoy markers entering harbor from seaward
13. Required shipboard lights for night operation: sail and power
14. Ships operation at night/navigation at night/identification of night navigation aids
15. Sailing/navigating of sailing vessel on weather course
16. Right of way determined by shipboard lights at night
17. D.R. navigation run by ships log and compass only; through harbor transit under power
18. Demonstration and use of AIS System

**Small Boat-FJ Instruction:**

NAUT 002 ax, bx Sail Only Lesson Plan (5 Class Meetings each) 20 hours

To reinforce skills demonstrated on the larger vessels, students will sail small boats without engines. Five lessons of four hours or four lessons at five hours each will cover the following material:

Day 1

1. Pre-Class
  - a. Lifejackets out
  - b. Registration
  - c. daily routine
2. You as a Sailor (SSR Ch. 1, pg. 8)
  - a. Environmental awareness
  - b. Dressing for sailing
  - c. Physical fitness
3. Safety (SSR Ch. 2, pg. 12)
  - a. Life Jackets
  - b. Communication:
    - 1) Verbal/non-verbal
    - 2) Whistles, hand signals
4. Wind Awareness (SSR Ch 4, pg. 20) “Outside Drill”
  - a. Why do we need wind?
  - b. Signs of wind and wind direction
  - c. Cannot sail straight into the wind (No-Go Zone)
5. Parts of a Sailboat (SSR Ch. 3, pg. 16)
  - a. Parts of the hull: bow, stern, transom, port, starboard, keel, rudder, tiller, tiller extension
  - b. Parts of the rig: Mast, boom, shrouds, spreaders, halyards
  - c. Lines and sheets: Mainsheet, jibsheet, boomvang, traveler
6. Rigging the Boat (SSR Ch. 6, pg. 28)
  - a. Taking off covers
  - b. Rigging the mainsail
  - c. Rigging the jib
7. First Sail (SSR Ch. 7, pg. 34)
  - a. Boarding the boat

- b. Crew positions
- c. Steering with the tiller
- d. Starting/Stopping--Sail Trim
- e. Tacking
- 8. De-rigging the Boat
  - a. Tying the boat to the dock
  - b. Folding sails
  - c. Covers

Day 2

- 1. Review
  - a. First sail
  - b. Wind awareness/Today's Weather
  - c. Parts of a sailboat
  - d. Rigging the boat
  - e. Parts of the Sail "New" (SSR, pg. 28)
- 2. Points of Sailing/Sailing Directions (SSR Ch. 8, pg. 42)
  - a. No-go zone
  - b. Close Hauled/Upwind/Beating
  - c. Close Reach
  - d. Beam Reach
  - e. Broad Reach
  - f. Running/Downwind
- 3. Trimming Sails
  - a. Trim for all points of sailing
- 4. Tacking/Reach to Reach (SSR pg. 41 and 50)
  - a. Heading Up: Tiller Toward the Sail
  - b. No-go zone: Switch Sides
  - c. Tiller Straight: Off you go!
  - d. Possible problems (SSR pg. 51)
- 5. Jibing (SSR pg. 59)
  - a. Heading Down: Tiller Away from the Sail
  - b. Dead Down Wind: Switch Sides
  - c. Possible Problems
- 6. Docking (SSR Ch. 13, pg. 68)
  - a. Glide Zone
  - b. Coast to a stop
  - c. Site specific docking techniques
- 7. Sailing Plans
  - a. Sailing Area
  - b. Crosswind drills
    - 1) Oval
    - 2) Figure 8
  - c. Free sailing

Day 3

- 1. Review
  - a. Wind/Today's Weather
  - b. Parts of Sailboat/Sail
  - c. Points of Sailing/Sailing Directions/Sail Trim

- d. Tacking
- e. Jibing
- 2. Upwind Sailing (SSR Ch. 9, pg 48)
  - a. Taking upwind
  - b. Key points (SSR pg. 53)
- 3. Downwind Sailing (SSR Ch. 10, pg. 56)
  - a. Points of Sailing/downwind
  - b. Wing and Wind
  - c. By the Lee/Accidental Jibes
- 4. Sailing Plans
  - a. Sailing Area
  - b. Crosswind Drills (Review)
  - c. Windward/Leeward Drill
  - d. Free Sailing

Day 4/5

- 1. Review
  - a. Wind/Today's Weather
  - b. Parts of a Sailboat/Sail
  - c. Points of Sailing/Sailing Directions/Sail Trim
  - d. Tacking/Jibing
- 2. Right of Way Rules (SSR Ch. 15, pg. 80)
  - a. Avoiding Collisions
  - b. Starboard vs. Port
  - c. Leeward vs. Windward
  - d. Overtaken vs. Overtaking
  - e. Sailboats vs. powerboats
  - f. Commercial vs. Pleasure
  - g. Taking vs. On a Tack (room to tack exception)
- 3. Knots (SSR Ch. 18, pg. 94)
  - a. Figure 8
  - b. Bowline
  - c. 2 Half Hitches
  - d. Clove Hitch
  - e. Cleat Hitch
- 4. Sailing Plans
  - a. Sailing Area
  - b. Crosswind Drills (Review)
  - c. Windward/Leeward Drill (Review)
  - d. Free Sailing

Day 4/5

- 1. Review
  - a. Parts of sailboat/Sail
  - b. Points of Sailing/Sailing Directions/Sail Trim
  - c. Tacking/Jibing
  - d. Right of Way Rules
- 2. Weather (SSR Ch. 17, pg. 88)
  - a. Sources of Information
  - b. Warnings: Small Craft Warnings



- c. High and Low Pressure
- d. Fronts
- e. Sea Breeze
- 3. Overboard Recovery (SSR Ch. 12, pg. 66)
  - a. Three methods:
    - 1) Quick Turn Method (tack around)
    - 2) Jibing Method (jibe around)
    - 3) Heave-To Method (tack around/back jib)
  - b. Retrieval (SSR pg. 65)--over the transom
- 4. Sailing Plans
  - a. Sailing Area
  - b. Windward/Leeward Drill (review)
  - c. Free Sailing
- 5. Written Exam

**Practical Operations Aboard 120' Brigantine Sailing Vessel - 3 day voyage**

- 1. Marlin Spike Seamanship
  - a. Tools of a sailor
  - b. Basic Knots
  - c. Other Skills
- 2. Parts of a Ship
  - a. Masts and Spars
  - b. Standing Rigging
  - c. Parts of the Vessel
- 3. Sails and Running Rigging
  - a. Square Sails
  - b. Headsails and Staysails
  - c. Gaff Mainsail
  - d. Gaff Topsail
  - e. Lifts and Braces
  - f. Pinrails
- 4. Setting, Dousing and Furling Sails
  - a. Organization
  - b. Safety
  - c. Setting Sail
  - d. Unfurling
  - e. Setting Square sails
  - f. Setting Headsails and Staysails
  - g. Setting the Mainsail
  - h. Setting the Gaff Topsail
  - i. Dousing Sail
  - j. Furling Sail
  - k. Reefing the Mainsail
  - l. Reefing the Fore Staysail
- 5. Trimming Sail
  - a. Bracing and Cockbill
  - b. Trimming Square Sails
  - c. Trimming Fore and Aft Sails
- 6. Sail Maneuvers
  - a. Tacking
  - b. Wearing

- c. Boxhauling
- d. Heaving To
- 7. Shipboard Emergencies
  - a. Man Overboard
  - b. Fire
  - c. Abandon Ship
- 8. Electronic Navigation; Dead Reckoning; Coastal Piloting; Celestial Navigation
  - a. Navigation orientation—initial dockside fix, course and distances for entire voyage
  - b. AIS, GPS and radar orientation (pending equipment availability aboard brigantine)
  - c. Chart reading-discussion of Catalina anchorages with regard to local weather conditions-use of chart symbols-nominal/geographic range of lights
  - d. Bow beam bearing procedures between helmsman and navigator for the purpose of starting/recording ship's speed log
  - e. Operational ship's watch procedures (navigation watch/deck watch)
  - f. Manmade and natural ranges
  - g. Rules of the road and rights of way: power and sail; day shapes, required shipboard lights for night operation and right of way determination: sail and power; traffic lane determination; definition of relative bearings/collision bearings: collision course determination at sea by AIS, visual bearing, radar bearing and sound bearing in fog
  - h. Speed-time-distance problems: calculator/formulae
  - i. Determining vessel speed by timing passing object:  $\text{speed in knots} = .6 \times \text{length of travel divided by the seconds}$
  - j. Predicting ETA
  - k. Use of bow beam bearings to indicate distance off a mark; check by radar and GPS
  - l. Navigational turn bearings and running fixes
  - m. Location of submarine canyon by use of depth finder coordinated with ETA/speed, time, and distance
  - n. Statement of position demonstration by bearing/distance (use of radar and GPS) Statement of position every hour by latitude and longitude; by bearing/distance (use of the stadimeter)
  - o. Demonstration of the use of ship's radio: U.S. Coast Guard emergency channel 16, bridge to bridge channel 13, weather information channels