Course number and title

ORE 654 Applications of Ocean Acoustics

2. Credits and contact hours

   3 credits, 37.5 hours/semester (30 1.25-hour classes)

3. Instructor's or course coordinator's name

   Bruce M. Howe

4. Textbook, title, author, and year
   a. Textbook: Sounds in the Sea, Medwin, Cambridge University Press, 2005
   b. Reference Books
      i. Principles of Sonar Performance Modeling, Ainslie, Springer, 2010
      ii. Underwater Acoustics: Analysis, Design and Performance of Sonar, Hodges, Wiley, 2010
      iii. Inverse Problems in Underwater Acoustics, Taroudakis and Makrakis, Springer, 2001
      iv. Fundamentals of Acoustical Oceanography, Medwin and Clay, Associated Press, 1998
      v. Ocean Acoustic Tomography, Munk, Worcester, and Wunsch, Cambridge University Press, 1995
      vi. Oceanography and Acoustics: Prediction and Propagation Models, Robinson and Lee, American Institute of Physics, 1994
      vii. The Sonar of Dolphins, Au, Springer-Verlag, 1993
      viii. Underwater Acoustic Systems, Coates, John Wiley & Sons, 1989
      ix. Sound transmission through a fluctuating ocean, Flatte, Cambridge University Press, 1979
      x. Acoustical Oceanography, Clay and Medwin, John Wiley & Sons, 1977
      xi. Principles of Underwater Sound, Urick, McGraw-Hill, 1975

5. Specific course information
   a. Course Content: Using sound to observe the ocean. Fundamentals of propagation, sources and receivers, radiated sound and scattering, bubbles, waveguides, scattering at rough surfaces, and bioacoustics. Topics include: marine mammals, fish and plankton imaging, navigation and communication, sound of seismics, ships, wind and rain, using sound to study ocean dynamics, flow imaging and measurement, mapping the seafloor and the combined forward/inverse problem.
   b. Prerequisite: Consent of instructor
   c. Designation: Elective

6. Specific goals for the course
   a. Student Outcomes
      i. (1) Fundamentals: (1) Understand the fundamentals of wave propagation, (2) Further develop understanding of mathematics science, and engineering fundamentals.
      ii. (2) Core Program: (1) Understand how sound propagates through the ocean environment, (2) Understand how to use sound propagation to observe the ocean, (3) Understand the sound of seismics, ships, wind and rain, biology and their use in studies of ocean dynamics and imaging and mapping the seafloor
      iii. (3) Option areas: (1) Estimate sound production of marine renewable energy systems, (2) Learn the basics of ocean acoustics instrumentation
      iv. (4) Problem formulation: (1) Develop conceptual models for acoustic problems, (2) formulate the combined forward/inverse problems, (3) derive solution schemes

v. (6) Communication: (1) contribute to coherent class discussions, (2) Use appropriate language and grammar, (3) prepare technical reports with proper format and style, (4) cite information sources appropriately, (4) be organized, clear and concise, (5) Understand and respond effectively to questions and feedback.
vi. (7) Ethical & Professional Responsibility: (1) be aware of environmental and societal impacts of acoustic instruments in oceans
vii. (10) Constant learning: (1) recognize the need for constant learning, (2) use proper online and traditional resources to gather information and data, (3) conduct technical literature search for materials not covered in the ORE program.

7. Brief list of topics to be covered
   a. Fundamentals: Simple propagation, rays, sources and receivers, radiated sound, bioacoustics, waveguides, scattering by bubbles, interior fluctuations, and rough surfaces
   b. The near surface ocean: upper ocean boundary layer and rain
   c. Bioacoustics: sensing of plankton and nekton; passive acoustics and marine animals, marine mammals
   d. Ocean Dynamics: tomography, time reversal, turbulence
   e. Ocean Bottom: imaging hydrothermal vents, large scale mapping
   f. Other topics: noise from pile driving, ocean energy devices, etc.