

<b>1 Module Details</b>	
<b>Module Name</b>	<b>Sonar System Operating Principles</b>
<b>Nominal duration</b>	It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 40 hours
<b>Module code</b>	NUE172
<b>Discipline code</b>	0703205
<b>2 Module purpose</b>	This module will provide the student with knowledge of the operating principles of sonar systems
<b>3 Prerequisites</b>	NUE178 Principles of Underwater Sound Transmission
<b>4 Relationship to competency standards</b>	This module provides some of the knowledge and skills underpinning competencies in the following standards: National Electrotechnology Industry Standards, Unit NES206c Metals & Engineering Industry Standards, Units MEM 18.57A
<b>5 Content</b>	<ol style="list-style-type: none"><li>1. Test Equipment<ul style="list-style-type: none"><li>• Applications<ul style="list-style-type: none"><li>• Analogue and Digital Oscilloscopes</li><li>• High voltage probes</li><li>• Insulation Testers</li><li>• Frequency Counters</li><li>• Logic probes</li><li>• DC and AC multimeters</li><li>• Spectrum Analysers</li><li>• Calibration</li><li>• Errors of measurement &amp; their effects</li></ul></li></ul></li><li>2. Sonar Equipment<ul style="list-style-type: none"><li>• Definition</li><li>• Block diagram</li><li>• Types</li><li>• Basic operation</li></ul></li><li>3. Sonar Applications/Tasks<ul style="list-style-type: none"><li>• Search</li><li>• Attack</li><li>• Noise Making</li><li>• Navigation</li><li>• Bottom search</li><li>• Communication</li><li>• Oceanographic</li><li>• Active Intercept</li><li>• Torpedo Warning</li><li>• Classification<ul style="list-style-type: none"><li>• Blade rate, shaft rate, speed</li><li>• Identity of target</li><li>• Types of propulsion</li><li>• Bearing rate range</li><li>• Type of vessel</li></ul></li></ul></li></ol>

- Self noise monitoring
- Laser depth Sonar
- Underwater Communications
- Echo sounder
- Fish Finder

4. Sonar Assemblies

- Operating Characteristics and Parameters
  - Transducer
  - Input Amplifier
  - Sonar interface unit
  - Beamforming network (transmit / receive)
  - Signal processing
  - Own Doppler Nullification
  - Display system
  - Headset
  - Interfaces
  - Transmitter
  - T/R Switch
  - Timer/Timing

5. Sonar operating parameters

- Power
- Bandwidth
- Gain (receiver)
- Efficiency
- Voltage
  - High
  - Low
- Cooling
- Display
  - Range switching
  - Definition
  - Sweep characteristics
  - Stability
  - Interfacing
  - Signal flow
  - Testing /adjustments
  - Installation requirements
- Frequency
  - Range
  - Applications
  - Classification
  - Doppler Effect

6. Sonar Transmission Characteristics

- Transmission Types
  - Omni Transmission
  - Stereo Transmission
  - Phased Transmission
- Transmission Parameters
  - Continuous Wave
  - Frequency Modulation
  - Amplitude Modulation

<b>6 Assessment strategy</b>	
<b>Assessment methods</b>	Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.
<b>Conditions of assessment</b>	Normally learning and assessment will take place in a classroom/ laboratory environment
<b>7 Learning Outcome Details</b>	
<b>Learning Outcome 1</b>	Describe the basic operating principles of a sonar system
<b>Assessment criteria</b>	<ol style="list-style-type: none"><li>1.1 Define the term Sonar.</li><li>1.2 Define active and passive sonar.</li><li>1.3 Describe the basic operating principles of a sonar system</li><li>1.4 Draw the block diagram of an active and passive sonar system</li><li>1.5 Describe the basic principles of target distance and bearing determination.</li></ol>
<b>Learning Outcome 2</b>	Describe the major components and operating parameters of active and passive sonar systems
<b>Assessment criteria</b>	<ol style="list-style-type: none"><li>2.1 Explain the major components of active and passive sonar systems.</li><li>2.2 Describe the operating parameters of a typical sonar system.</li><li>2.3 State the advantages and disadvantages of active and passive sonar.</li><li>2.4 Describe the effect of measurement errors that can occur when measuring the parameters associated with sonar devices.</li><li>2.5 Operate test and sonar equipment to make measurements of parameters associated with sonar devices.</li><li>2.6 Calculate the active and passive sonar equations using the following parameters<ul style="list-style-type: none"><li>• Source Level (SL)</li><li>• Propagation Loss (PL)</li><li>• Background noise (B)</li><li>• Directivity Index (DI)</li><li>• Signal to Noise Ratio (SNR)</li><li>• Target Strength (TS)</li></ul></li></ol>

<b>Learning Outcome 3</b>	Describe the operating modes of active and passive sonar systems.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>3.1 Calculate the active and passive sonar equations.</li> <li>3.2 List typical vessel propulsion systems and their effect on sonar signals.</li> <li>3.3 Describe the use of sonar systems to determine the type of vessel, identity of the target and the bearing range rate.</li> <li>3.4 Describe the search, attack, noise making, active intercept, and torpedo warning modes of operation of a sonar system.</li> <li>3.5 Describe a range of typical Sonar applications</li> </ul>
<b>Learning Outcome 4</b>	Outline transmission characteristics associated with sonar systems.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>4.1 Describe typical types of sonar transmission.</li> <li>4.2 Describe typical transmission parameters and how they relate to types of sonar transmission identified in 4-1:</li> <li>4.3 List the advantages and disadvantages of transmission types described in 4-1</li> </ul>
<b>Learning Outcome 5</b>	Outline the features of appropriate Sonar test equipment.
<b>Assessment criteria</b>	<ul style="list-style-type: none"> <li>5.1 Describe the characterising parameters associated with sonar devices for both active and passive sonar.</li> <li>5.2 List and describe appropriate sonar test equipment.</li> <li>5.3 Describe appropriate calibration procedures for sonar test equipment.</li> <li>5.4 Describe the effect of measurement errors that can occur when measuring the parameters associated with sonar devices.</li> </ul>
<b>8 Delivery of the module</b>	
<b>Delivery strategy</b>	Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective way to achieve this is by the integration of theory and practice where students learn by experimentation and through research and laboratory reports. It is recommended that learning and assessment be facilitated in a holistic manner, which may require a learning outcome sequence other than that indicated in the module.
<b>Resource requirements</b>	Resources should be sufficient for students to carry out practical exercises on an individual basis.
<b>Occupational health and safety requirements</b>	A safe and healthy environment will be provided for students and teachers as well as safety procedures with regard to teaching/learning activities.