Higher National Unit specification: general information

Unit title: Marine Engineering: Advanced Naval Architecture

Unit code: H0ED 35

Superclass: XQ

Publication date: January 2012

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is designed to enable candidates to develop their knowledge and understanding of Advanced Naval Architecture. The Unit will allow candidates to apply the principles of naval architecture in ship construction.

On completion of the Unit the candidate should be able to:

1 Perform calculations involving Simpsons First rule, large angle stability and free surface.
2 Calculate ships trim due to bilging and principle forces on rudders.
3 Perform calculations involving ships structural strength and resistance.

Recommended prior knowledge and skills

Candidates should have knowledge of Mathematics and/or Physics. This may be demonstrated by possession of Mathematics and/or Physics at SCQF level 6 or possession of an HNC Marine Engineering Group Award at SCQF level 7 which contains Naval Architecture.

Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

General information (cont)

Core Skills

There are opportunities to develop the Core Skills of *Numeracy, Communication* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed in the subject area of the Group Award to which it contributes.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Perform calculations involving Simpsons First rule, large angle stability and free surface.

Knowledge and/or Skills

- Simpson's Rule
- Free Surface Effect
- Stability
- Wall-Sided Vessel Stability
- Effect of Form on Stability
- Ships Stability Statutory Information

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

Evidence for the Knowledge and/or Skills items in Outcome 1 should be provided on a sample basis. Each candidate will need to demonstrate that they can answer correctly questions based on a sample of the knowledge and skills items. In any assessment of this Outcome, **four out of six** Knowledge and/or Skills items should be sampled. Evidence should be generated through closed-book assessment of 1 hour duration in supervised conditions.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four out of six Knowledge and/or Skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

- Calculate second moments of area using Simpsons First Rule
- Calculate free surface effect
- Calculate Large angle stability
- Calculate stability of wall sided vessels
- Understand the effects of form stability
- Discuss the statutory requirements for the carriage of stability data on ships

Where calculations are performed the candidate must:

- Apply appropriate formulae
- Apply the principles of the calculation
- Show all working through a calculation
- Ensure the answer should derive from the application of the formula and correct application of the principles of the calculation
- Not use formula sheets during this Outcome
- Candidates are permitted to use scientific calculators

Outcome 2

Calculate Ships trim due to bilging and principle forces on rudders.

Knowledge and/or Skills

- Trim
- Large Mass Trim
- Bilging
- Ship Design
- Rudders

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 2 will be provided on a sample basis. Each candidate will need to demonstrate that they can correctly answer questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **four out of five** Knowledge and/or Skills items should be sampled. Evidence should be generated through closed-book assessment of 1 hour duration in supervised conditions.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four from five Knowledge and/or Skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

- calculate end draughts
- evaluate the effect of large mass movement
- calculate change of draught due to bilging
- determine the effect of ship design on bilging
- calculate angle of heel due to rudder movement

Where calculations are performed the candidate must:

- apply appropriate formulae
- apply the principles of the calculation
- show all working through a calculation
- ensure the answer should derive from the application of the formula and correct application of the principles of the calculation
- not use formula sheets during this Outcome
- candidates are permitted to use scientific calculators

Outcome 3

Perform calculations involving ships Structural strength and Resistance

Knowledge and/or Skills

- Ship Resistance
- Propellers
- Propeller Cavitation
- Ships' Trials
- Shear Force & Bending Moments in Still Water
- Ship Stresses

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Advanced Naval Architecture

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 3 will be provided on a sample basis. Each candidate will need to demonstrate that they can correctly answer questions based on a sample of the knowledge and skills items. In any assessment of this Outcome, **four out of six** Knowledge and/or Skills items should be sampled. Evidence should be generated through closed-book assessment of one hour duration in supervised conditions.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four from six Knowledge and/or Skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

- Calculate ships resistance
- Calculate ship powers.
- Discuss cavitation and its effects
- Discuss speed trials and their value
- Calculate Sheer Force and Bending Moments in Still Water
- Identify ships stresses and their causes

Where calculations are performed the candidate must:

- apply appropriate formulae
- apply the principles of the calculation
- show all working through a calculation
- Ensure the answer should derive from the application of the formula and correct application of the principles of the calculation
- Not use formula sheets during this Outcome
- Candidates are permitted to use scientific calculators

Higher National Unit specification: support notes

Unit title: Marine Engineering: Advanced Naval Architecture

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit is primarily aimed at candidates who intend to seek sea going employment as a Merchant Navy Engineering Officer and the Unit will meet the Merchant and Coastguard Agency (MCA) requirements up to Class 1 Certificate of Competency.

This Unit has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:

1 The use of concepts and theorems to solve problems on Stability data.

2 The use of concepts and theorems to calculate Trim and Rudder Forces.

3 The use of concepts and theorems to solve problems involving ships Structural strength and Resistance.

In designing this Unit the Unit writers have identified the range of topics they would expect to be covered by lecturers. Recommendations are given as to how much time should be spent on each Outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for a centre to use this list of topics it is strongly recommended that it does so to ensure continuity of teaching and learning across the Advanced Naval Architecture Unit, the list of topics is given below. Lecturers are advised to study this list of topics in conjunction with the knowledge/skills section of this document so that they can get a clear indication of the standard of achievement expected of candidates in this Unit.

1 Perform calculations involving Simpsons First rule, large angle stability and free surface.

- Calculate second moments of area using Simpson's first rule.
- Understand the effect of free surface liquids on transverse stability and solve problems involving free surface.
- Use cross curves of stability to produce curves of statical stability.
- Use particular features of wall sided vessels to obtain an approximation to the stability of a ship.
- Understand the effects of form on stability.
- Comprehend stability information supplied to ship.

2 Calculate Ships trim due to bilging and principle forces on rudders.

- Calculate the effects on the end draughts of addition, removal, or longitudinal movement of small masses.
- Determine ship end draughts using hydrostatic data.
- Calculate change in end draughts of box shaped vessels due to bilging a compartment which is not at mid-ships.
- Identify the elements of ship design which reduce the effects of bilging.
- Understand the principle forces acting on a ship and rudder, when helm is applied to a vessel.

3 Perform calculations involving ships Structural strength and Resistance.

- Calculate the power required to drive a ship from the resistance to motion exerted by the water on a ship at any given speed.
- Calculations involving relationship between powers.
- Identify the phenomenon of propeller cavitation, its causes and effects.
- Appreciate the reasons for carrying out ships' trials, and the value of the data obtained.
- Evaluate shear forces and bending moments on ships of simple geometric form.
- Recognise the causes and effects of stresses acting on ships.

Guidance on the delivery of this Unit

This Unit could be delivered by a combination of class teaching, tutorial work and practical laboratory work where appropriate. The latter is seen as particularly important as it provides candidates with an opportunity to relate theoretical knowledge to a practical context. The Unit has been designed to incorporate sufficient time to allow lecturers to teach all the core Naval Architecture principles.

Where this Unit is incorporated into other Group Awards it is recommended that it be delivered in the context of the specific occupational area(s) that the award is designed to cover.

The Unit has been written in such a way that there is sufficient time built in to allow candidates to practise what they have learnt through formative assessments.

Guidance on the assessment of this Unit

Assessment should be carried out under closed-book supervised conditions. Each Outcome could be assessed separately in a paper which lasts no more than one hour. However, the assessment could take place as one assessment event which combines all Outcomes. Each Outcome could comprise of four questions taken on a sample basis as laid out in the Evidence Requirements for each Outcome.

A different sample of the knowledge and/or skills should be chosen when re-assessing candidates.

Higher National Unit specification: support notes (cont)

Unit title: Marine Engineering: Advanced Naval Architecture

Assessment Guidelines

Outcome 1

Outcome 1 could comprise of four calculation questions taken on a sample basis as laid out in the Evidence Requirements. Assessment could take place as one assessment or each Outcome may be assessed on its own.

Outcome 2

Outcome 2 could comprise of four calculations questions taken on a sample basis as laid out in the Evidence Requirements. Assessment could take place as one assessment or each Outcome may be assessed on its own.

Outcome 3

Outcome 3 could comprise of four questions which are a combination of calculation and explanation taken on a sample basis as laid out in the Evidence Requirements. Assessment could take place as one assessment or each Outcome may be assessed on its own.

Online and Distance Learning

The Unit is suitable for Open Learning use although assessment would have to take place under controlled conditions.

Opportunities for developing Core Skills

The delivery and assessment of this Unit could contribute towards the components *Numeracy, Problem Solving* at SCQF level 6 because of the requirements to carry out calculations and solve problems in Outcomes 1, 2 and 3, and *Communication* at SCQF level 6 because of the requirement to explain residuary and frictional resistance in Outcome 3.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**

History of changes to Unit

Version	Description of change	Date

General information for candidates

Unit title: Marine Engineering: Advanced Naval Architecture

This Unit has been designed to allow you to develop knowledge, skills and understanding in Naval Architectural principles and concepts as used in Marine Engineering.

This Unit will also allow you the opportunity to develop the necessary knowledge and skills to evaluate Naval Architecture as used in marine applications.

The Unit may consist of three assessment papers lasting no more than one hour per paper. The assessment will be conducted under closed-book conditions in which you will not be allowed to take notes, textbooks, etc into the assessment. However, you will be allowed to use a scientific calculator. You may sit assessment papers at the end of each Outcome.

This Unit will enable you to:

1 Perform calculations involving Simpsons First rule, large angle stability and free surface.
2 Calculate Ships trim due to bilging & principle forces on rudders.
3 Perform calculations involving ships Structural strength and Resistance.

There are opportunities to develop Core Skill components in *Numeracy* and *Problem Solving* at SCQF level 6 because you will be asked to carry out calculations and solve problems in Outcomes 1, 2 and 3. In addition you will have an opportunity to develop a component of the Core Skill *Communication* at SCQF level 6 because of the requirement for you to explain residuary and frictional resistance in Outcome 3.