Higher National Unit specification: general information

Unit title: Marine Engineering: Electrical Power

Unit code: H0EH 34

Superclass: XQ

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Version: 01

Unit purpose

This Unit is designed to enable candidates to develop knowledge and understanding in Marine Electrical Power. It is designed as part of the HND Marine Engineering award and should give the Marine Engineering candidate a greater appreciation of electrical and electronic power circuits. Candidates will study non linear and resonant circuits and the use of electronic devices in power circuits.

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

1 Solve problems on dc linear and non-linear circuits.
2 Solve problems, by calculation and phasor diagrams, on single phase and three phase ac circuits.
3 Evaluate and describe the use of electronic devices in power circuits.

Recommended prior knowledge and skills

Access to this Unit is at the discretion of the centre. However, it would benefit the candidates to have completed the HNC Unit *Marine Engineering: Electrical and Electronic Devices* and have a knowledge and understanding of Mathematics and/or Physics at SCQF level 6.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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, Problem Solving* and *Communication* at SQCF level 6 and *Working with Others* 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 within the subject area of the Group Award to which it contributes.

Higher National Unit specification: statement of standards

Unit title: Marine Engineering: Electrical Power

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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

Solve problems on dc linear and non-linear circuits.

Knowledge and/or Skills

- Kirchhoff's Law to steady state dc circuits
- Transient voltage and current relationships
- R-L and R-C circuits.
- Non-linear devices.
- V/I law.
- Problems relating to non-linear circuits

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical Power

Evidence Requirements

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 listed in the Outcome. In any assessment of this Outcome, **three out of six** Knowledge and/or Skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of **three 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. An alternative sample should be used for reassessment of candidates.

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:

- Solve steady state dc circuit problems involving no more than 3 unknowns using Kirchhoff's Law
- Graphically describe transient voltage and current relationships in simple R-L and R-C circuits when switching on and off
- Use exponential growth and decay formulae to calculate current or voltage values at a given time in R-L and R-C circuits
- Describe non-linear devices
- Solve problems relating to simple non-linear circuits given the V/I law
- Solve problems relating to simple non-linear circuits graphically using load-line or dynamic characteristics

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 derives from the application of the formula and correct application of the principles of the calculation.

Evidence should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical Power

Outcome 2

Solve problems, by calculation and phasor diagrams, on single phase and three phase ac circuits.

Knowledge and/or Skills

- Impedance of R-L-C circuit combinations.
- Resonant frequency of a R-L-C series circuit.
- Single phase circuits.
- Power factor correction in single phase circuit.
- Phasor diagrams.
- Phasor diagrams to show relationship.
- 3-phase balanced circuit.

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 seven** Knowledge and/or Skills items should be sampled.

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 seven** Knowledge and/or Skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items. An alternative sample should be used for reassessment of candidates.

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 impedance of R-L-C circuit combinations in series and parallel
- Calculate the resonant frequency of a R-L-C series circuit
- Solve problems relating to single phase active, apparent and reactive power
- Solve problems relating to pf correction in single phase circuit
- Use phasor diagrams to describe 3-phase star and delta voltage and current
- Use phasor diagrams to show the relationship between line and phase voltage and current for star and delta connections
- Solves problems relating to 3-phase balanced circuit using voltage current and power

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 derives from the application of the formula and correct application of the principles of the calculation

Evidence should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Outcome 3

Evaluate and describe the use of electronic devices in power circuits.

Knowledge and/or Skills

- Half wave, bi-phase and bridge rectification circuits.
- Capacitor only smoothing,
- Mean dc rectified voltage.
- Thyristor construction.
- The operation of thyristor circuits.
- The operation of zener diodes with forward and reverse bias voltage applied.
- dc stabiliser circuit.
- The construction and operation of pnp and npn bi-polar transistors.
- Current flow in a transistor switching circuit.

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 3 will be provided on a sample basis. The evidence may be presented in responses to specific questions. 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, **five out of nine** Knowledge and/or Skills items should be sampled.

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

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical Power

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:

- Describe and appraise half wave, bi-phase and bridge rectification circuits supplied from single and three phase supply circuits
- Describe C-only smoothing
- Calculate mean dc rectified voltage for half and full wave single phase circuits given ac input supply and vice versa
- Describe the construction of a thyristor
- Sketch a thyristor circuit using variable phase shift control, and typical load current and voltage
- Describe and appraise the operation of zener diodes with forward and reverse bias voltage applied
- Analyse a simple dc stabiliser circuit by calculating values of voltages, currents and powers under change of load and supply voltage
- Describe the construction and analyse the operation of pnp and npn bi-polar transistors in common base, common emitter and common collector connections
- Calculate the current flow in a transistor switching circuit used for control or alarm purposes

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 derives from the application of the formula and correct application of the principles of the calculation

Evidence should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Higher National Unit specification: support notes

Unit title: Marine Engineering: Electrical Power

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.

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 electrical/electronic context. The Unit has been designed to incorporate sufficient time to allow lecturers to teach all the core electrical/electronic principles in the Unit.

As this Unit provides core electrical/electronic principles that further develop much of the studies in other areas of the HNC and HND Marine Engineering awards, it is recommended that the Unit be delivered towards the start of the HND Marine Engineering award.

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 such that there is sufficient time built in to allow candidates to practise what they have learnt through appropriate formative assessments or laboratory work.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions. This assessment must include three of the six Evidence Requirements for Outcome 1, four out of the seven Evidence Requirements for Outcome 2 and five out of the nine Evidence Requirements for Outcome 3. In the case of a reassessment, different samples of the Evidence Requirements for each should be used.

Higher National Unit specification: support notes (cont)

Unit title: Marine Engineering: Electrical Power

Guidance on the assessment of this Unit

The assessment for all three Outcomes could be combined together into one assessment paper which candidates should sit at one single assessment event lasting no more than two hours and should be carried out under supervised, controlled conditions.

Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

If a candidate requires to be re-assessed, a different selection of questions must be used from all sections. A significant proportion of the questions used in the re-assessment must be different from those used in the original test.

Assessment Guidelines

Outcome 1

The assessment of this Outcome could be combined together with that for Outcomes 2 and 3 to form a single assessment paper.

Outcome 2

The assessment of this Outcome could be combined together with that for Outcomes 1 and 3 to form a single assessment paper, details of which are given under the Evidence Requirements for Outcome 3.

Outcome 3

The assessment of this Outcome could be combined together with that for Outcomes 1 and 2 to form a single assessment paper. This single assessment paper could be taken at a single assessment event lasting no more than two.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

If a candidate requires to be re-assessed, a different selection of questions must be used from all sections. A significant proportion of the questions used in the re-assessment must be different from those used in the original test.

Online and Distance Learning

Although this Unit could be delivered by distance learning, it would require a considerable degree of planning by the centre to ensure the sufficiency and authenticity of candidate evidence. Arrangements would have to be made to ensure that the closed-book test for Outcomes 1, 2 and 3 is delivered in a supervised environment.

Higher National Unit specification: support notes (cont)

Unit title: Marine Engineering: Electrical Power

Opportunities for developing Core Skills

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

The delivery and assessment of this Unit may contribute towards the Component 'Using Number' of the core skill of *Numeracy* at SQCF level 6 in Outcomes 1, 2 and 3. The specific skills required for the component at SQCF 6 include: working confidently with a numerical/statistical concept; deciding on the numerical operations to be carried out; and carrying out complex calculations on a number of sustained calculations. This is likely to fit in with a variety of the topics in Outcomes 1,2 and 3 (eg Use exponential growth and decay formulae to calculate current or voltage values at a given time in R-L and R-C circuits, etc). It is also likely that the component 'Using Graphical Information' at SCQF level 6 could also be developed in the context of Outcomes 1 and 2. This core skill could be developed here without formal certification.

The Unit may allow candidates to complete laboratory work which may allow them to develop the component Oral Communication of the core skill *Communication* at SCQF level 6. In a marine engineering laboratory when candidates are set a problem they may have the opportunity to develop the specific core skill elements 'Use vocabulary and a range of spoken language structures consistently and effectively at an appropriate level of formality' and 'Respond to others, taking account of their contributions'.

This Unit may allow candidates to complete laboratory work and formative assessment which may allow them to develop 'Reviewing Co-operative Contribution' of the core skill *Working with Others* at SCQF level 6. Through the candidates' laboratory work and formative assessments this may allow them to develop the specific skills 'Evaluate overall co-operative working, considering own involvement and the involvement of others, referring to supporting evidence', 'Draw conclusions and justify them with reference to supporting evidence" and "Identify own learning and objectives for future co-operative working'.

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: Electrical Power

This Unit has been designed to allow you to develop knowledge, skills and understanding in electrical and electronic 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 the operation of electrical and electronic circuits in marine applications.

You will also learn to apply electrical and electronic principles to Marine equipment in order to assess its overall performance.

It is good to gain sound theoretical knowledge and understanding but it is also important that you are able to set your theoretical knowledge within a practical Electrical context. Thus, it is likely during the Unit you will be provided with the opportunity to relate theory to practice by doing practical experiments.

There are opportunities for you in this Unit to gather evidence towards the core skill of *Numeracy* at SQCF Level 6 although there is no automatic certification of Core Skills or Core Skills components.

The formal assessment for this Unit could consist of a single assessment paper lasting no more than two hours. 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 this assessment paper at the end of the Unit.

The Outcomes you will study are

1 Solve problems on dc linear and non-linear circuits.
2 Solve problems, by calculation and phasor diagrams, on single phase and three phase ac circuits.
3 Evaluate and describe the use of electronic devices in power circuits.