National Unit Specification: general information

UNIT Nautical Science: An Introduction (SCQF level 6)

CODE F7HD 12

SUMMARY

This Unit is suitable for candidates who aspire to a career in the Merchant Navy or in associated sea going marine related occupations.

The aim of this Unit is to provide candidates with a basic knowledge physics required for progression onto higher level HN awards utilised in training merchant navy officers and cadets. On successful completion of the Unit candidates will have sufficient knowledge to allow them to cope with the requirements of the following HN Units:

F0LS 34: Celestial Navigation
F0M0 34: Navigational Maths and Science
F0LV 34: Chartwork and Tides
F0LD 34: Ship Stability: An Introduction

It is primarily aimed at candidates who intend to seek sea-going employment as a Merchant Navy Deck Officer. However it may also be studied by someone with an interest in the subject area.

OUTCOMES

1 Demonstrate an understanding of the concept of the celestial sphere and the movement of the sun stars and planets.
2 Demonstrate an understanding of the co-ordinate systems found on the earth's surface and the celestial sphere.
3 Demonstrate an understanding of applied mechanics relevant to marine operations.
4 Demonstrate an understanding of waves and optics relevant to marine navigation.
5 Demonstrate an understanding of the causes and effects of terrestrial magnetism with respect to marine navigation.

Administrative Information

Superclass: ZF

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Version: 01

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following:

Standard Grade (Credit/General) in a Science based subject (eg Physics, Chemistry, Biology or Dual/Combined Science)

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**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.*

CORE SKILLS

There are opportunities to develop the following Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Communication: Written at SCQF level 5
Communication: Reading at SCQF level 5
Numeracy: Using Number at SCQF level 5
Numeracy: Using Graphical Information at SCQF level 5

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Demonstrate an understanding of the concept of the celestial sphere and the movement of the sun stars and planets.

Performance Criteria

(a) Explains correctly the terms, galaxies, solar systems, stars, planets and moons.
(b) Explain correctly common terminology with respect to the celestial sphere.
(c) Explains accurately the apparent motion of the sun, planets and stars on the celestial sphere.

OUTCOME 2

Demonstrate an understanding of the co-ordinate systems found on the earth's surface and the celestial sphere.

Performance Criteria

(a) Explain correctly the terms Latitude, Longitude, Equator, Geographical Pole, d'lat and d'long.
(b) Describe the relationship between terrestrial and celestial co-ordinate systems.
(c) Use correctly the Nautical Almanac to determine position of celestial bodies.

OUTCOME 3

Demonstrate an understanding of applied mechanics relevant to marine operations.

Performance Criteria

(a) Describes the laws of motion in terms of time, velocity and acceleration.
(b) Explain correctly the terms Force, Momentum Angular Momentum, Kinetic and Potential energy with respect to mass, acceleration and velocity.
(c) Demonstrates an understanding of Forces as vectors and resolution of vector problems.
(d) Demonstrates an understanding of the concept of taking moments about an axis to find a resultant force.
(e) Describes correctly the relationship between work, energy and power.

OUTCOME 4

Demonstrate an understanding of waves and optics relevant to marine navigation

Performance Criteria

(a) Describe the electromagnetic spectrum
(b) Define the terms frequency, wavelength and amplitude
(c) Perform calculations accurately using the formula $c = f \times \lambda$
(d) Explain correctly reflection, refraction and diffraction of waves
(e) Describe correctly the radio spectrum as applicable to Marine Navigation

National Unit Specification: statement of standards (cont)

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OUTCOME 5

Demonstrate an understanding of the causes and effects of terrestrial magnetism with respect to marine navigation**.**

Performance Criteria

(a) Explain accurately the magnetic fields associated with simple magnets.
(b) Describe correctly the formation and characteristics of the Earths magnetic field.
(c) Explain accurately how the Earths magnetic field varies with location on the Earths surface.
(d) Interprets correctly the effect of the earth's magnetic field on a compass needle.
(e) Explain accurately the terms variation and deviation.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate the candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria.

All Outcomes may be assessed on an individual basis at appropriate points throughout the delivery of the Unit, or as a combination of Outcomes (eg Outcome 1 assessed on its own and Outcomes 2 and 3 together), or as a single, holistic assessment covering all five Outcomes. Assessment(s) must be conducted under supervised, closed-book conditions in which candidates may use reference materials provided by the centre but are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. Candidates should be allowed to use a non-programmable scientific calculator during assessment.

Outcome 1

To satisfy all the Evidence Requirements candidates must be able to:

- distinguish the difference between a Galaxy and the Solar System and describe their apparent motion across the celestial sphere
- explain a sample of four of the following terms:

  — Celestial Pole
  — Equinoctial
  — Celestial meridian
  — Declination
  — Ecliptic
  — Perihelion and Aphelion
  — Summer and Winter Solstice
  — Vernal and Autumnal equinox

National Unit Specification: statement of standards (cont)

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Outcome 2

To satisfy all the Evidence Requirements candidates must be able to:

- explain the Earths co-ordinate system and can define from a sample of four of the following:

  — Latitude
  — Longitude
  — Geographical Pole
  — Equator
  — Meridian
  — Parallel of latitude
  — Difference of latitude
  — Difference of longitude

- explain the similarities between celestial and terrestrial co-ordinates
- determine the LHA and declination of celestial body using the Nautical Almanac

Outcome 3

To satisfy all the Evidence Requirements candidates must be able to:

- perform simple calculations involving forces, mass and acceleration, including acceleration due to gravity
- describe the forces acting on a vessel in still water and a seaway, in general terms
- resolve vector and moment problems involving forces encountered at sea
- perform calculations involving work, energy and power in a marine context

Outcome 4

To satisfy all the Evidence Requirements candidates must be able to:

- draw simple ray diagrams to indicate the properties of reflection, refraction and diffraction of waves.
- find either the speed, wavelength or frequency of a wave given two of the values in the formula $c=f \times \lambda$ and describe the electromagnetic spectrum.
- describe the salient features of the radio spectrum as it applies to marine navigation and communications.

Outcome 5

To satisfy all the Evidence Requirements candidates must be able to:

- explain the Earths magnetic fields in terms of simple bar magnet
- explain how the total, horizontal and vertical components of the earth's magnetic field vary with location on the earth's surface and how this affects a compass needle
- explain the causes for variation and deviation

National Unit Specification: support notes

UNIT Nautical Science: An Introduction (SCQF level 6)

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 forms part of the National Certificate in Shipping and Marine Operations at SCQF level 6, but may also be offered on a free standing basis.

In Outcomes 1 and 2 candidates will develop knowledge and understanding of the Celestial Sphere and the earth in relation to marine navigation and be able to determine appropriate co-ordinates of places on the earth and of celestial bodies.

Candidate's will develop knowledge and understanding of the concept of the celestial sphere as an imaginary sphere on which all celestial objects are projected, as viewed from the earth, candidates will also gain knowledge of data tables that are currently in use at sea and nautical colleges throughout the world.

In Outcome 3 candidates will develop knowledge and understanding of mechanics with particular reference to marine applications, in particular use of vectors and resolution of vector problems bys graphical and mathematical means.

Candidates will also consider the basic theory of forces in terms of mass, acceleration, speed, velocity and energy relevant to applications in a marine environment. This will take the form of problem solving in the areas of stability calculations, hydrostatics, meteorology and chartwork and navigational sailings.

In Outcome 4 the candidates will discover the importance of the electromagnetic spectrum in relation to marine navigation and in particular will look at navigational instruments such as the sextant, binoculars and electronic position fixing aids such as radar and satellite navigation systems.

In Outcome 5 candidates will develop knowledge of the relevance of the properties of the earth's magnetic field to marine navigation. The theory of magnetic fields will be introduced to candidates so that they can appreciate that the earths field can be considered similar to that of a bar magnet.

The changes in magnetic field strength with location on the earth's surface will be investigated and the cause of magnetic variation and deviation determined.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence as the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit may be delivered by a combination of lectures, tutorial work, and computer simulation.

Independent learning should be encouraged by getting students to research appropriate websites to gain a deeper insight into some subject areas.

Computer simulation illustrating the different co-ordinate systems of the earth and celestial sphere are very useful and if possible be backed up by the use of star globes for demonstration purposes.
The internet contains a rich source of materials on nautical science. Many useful resources on general astronomy can be found on the NASA website.

The Unit should be fully supported with relevant learning materials (eg handouts in paper and electronic form, textbooks, on-line materials etc.)

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

There are opportunities to develop the following Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Communication: Written at SCQF level 5
Communication: Reading at SCQF level 5

Candidates will have to use written material and tables to determine positions of objects on the surface of the earth and on the celestial sphere. Accuracy in reading tables is essential to ensure the safety of vessels in navigation. Candidates will have to produce written work which is clear and concise and allows others to follow the flow of the work easily; they will also have to explain abstract concepts which are not immediately apparent whilst engaged on voyages at sea.

Numeracy: Using Number at SCQF level 5
Numeracy: Using Graphical Information at SCQF level 5

Candidates will be required to use simple formulas and present graphical information clearly and concisely. They will have to accurately interpret diagrams from nautical tables and the Nautical Almanac.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communications Technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge and understanding of celestial and terrestrial navigation principles plus a solid grounding in areas that will be encountered at a later date.

Regardless of whether assessment is carried out on an individual basis, as a combination of Outcomes or on a single, holistic basis any assessment paper(s) used may comprise a suitable balance of short answer, restricted response and structured questions.

National Unit Specification: support notes (cont)

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CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.