

The Operational Use of Electronic Chart Display and Information Systems (ECDIS)



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Foreword

Since its inception the International Maritime Organization has recognized the importance of human resources to the development of the maritime industry and has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. IMO has also responded to the needs of developing countries for postgraduate training for senior personnel in administration, ports, shipping companies and maritime training institutes by establishing the World Maritime University in Malmo, Sweden, in 1983.

Following the earlier adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, a number of IMO Member Governments had suggested that IMO should develop model training courses to assist in the implementation of the Convention and in achieving a more rapid transfer of information and skills regarding new developments in maritime technology. IMO training advisers and consultants also subsequently determined from their visits to training establishments in developing countries that the provision of model courses could help instructors improve the quality of their existing courses and enhance their effectiveness in meeting the requirements of the Convention and implementing the associated Conference and IMO Assembly resolutions.

In addition, it was appreciated that a comprehensive set of short model courses in various fields of maritime training would supplement the instruction provided by maritime academies and allow administrators and technical specialists already employed in maritime administrations, ports and shipping companies to improve their knowledge and skills in certain specialized fields. IMO has therefore developed the current series of model courses in response to these generally identified needs and with the generous assistance of Norway.

These model courses may be used by any training institution and the Organization is prepared to assist developing countries in implementing any course when the requisite financing is available.

W. A. O'NEIL

Secretary-General

Introduction

- The features of ECDIS

ECOIS systems offer numerous benefits compared to conventional navigation (automatic display of own ship's position, automatic updating, potential radar overlay, etc.) and are considered to be a significant step towards safer navigation. They will eventually replace paper charts on board many ships.

ECOIS must be able to provide at least the same navigational functions as a conventional paper chart. Unlike charts, ECOIS is a complex navigation system of a highly sophisticated level which includes not only a large number of navigational functions, but also components of a complex computer-based information system such as hardware, software, sensor inputs, specific ECOIS data and their presentation rules, status indications and alarms, man-machine interface, etc. Therefore, care must be taken when navigating with ECOIS and using its navigational functions to avoid misinformation and malfunctions. Although the minimum performance standards for ECOIS have been laid down, no real standards for hardware, data presentation software (ECOIS kernel) and man-machine interface exist. Consequently, it is expected that a variety of different equipment types will be installed on board ships.

Thus, time and effort must be invested in order to master ECOIS devices prior to their use. In the interests of safe navigation, training and certification requirements are necessary.

- IMO Requirements

- (a) Technical requirements

The minimum performance standards for ECOIS are laid down in IMO resolution A.817(19) "Performance Standards for ECOIS". However, when using ECOIS in a RCDS chart mode of operation there remains a requirement to carry an appropriate and up-to-date folio of paper charts.

- (b) Competence requirements

In the STCW 95 Convention, no particular formal emphasis is placed on ECOIS systems. Instead they are considered to be included under the term "charts" (Table A-II/1). Following the functional approach, the officer in charge of a navigational watch must have "thorough knowledge of and ability to use navigational charts and publications, ...". The methods for demonstrating competence are "using chart catalogues, charts, navigational publications, ... electronic navigation equipment ...". Criteria for evaluating competency are stated as "The charts selected are the largest scale suitable for the area of navigation and charts and publications are corrected in accordance with the latest information available". In Section B-11/1(Assessment of abilities and skills in navigational watchkeeping), a candidate for certification must provide evidence of skills and ability to prepare for and conduct a passage, "including interpretation and applying information from charts".

- (c) Performance standards

The minimum performance standards for ECOIS are laid down in IMO resolution A.817(19) "Performance Standards for Electronic Chart Display and Information Systems (ECDIS)".

- **Goals of this course**

The candidate shall be able to:

- operate the EGOIS equipment, use the navigational functions of EGOIS, select and assess all relevant information and take proper action in the case of a malfunction;
- state the potential errors of displayed data and the usual errors of interpretation; and
- explain why EGIOS should not be relied upon as the sole reliable aid to navigation.

- **The purpose of this model course**

The purpose of this course is to enhance safety of navigation by providing the knowledge and skills necessary to fully utilize the features of EGOIS. Furthermore, the purpose is to assist training institutions and their faculty in organizing and introducing new training courses for EGIOS. IMO has produced "Guidance on the implementation of model courses" which deals with this aspect in greater detail and is included as an attachment to this course. The model course may also be used to enhance, update or supplement existing training material in order to improve quality and effectiveness of the training courses offered by the institutes.

- **Preparing an ECDIS course on the basis of the model course**

To prepare and plan an EGOIS course, the instructor should review:

- the course framework,
- the course plan,
- the detailed syllabus, and
- the instructor manual of the model course.

Although the essential learning objectives for safe and efficient use of EGOIS are identified and laid down in this model course, the actual scope, content and length of a training course may be dependent on:

- the actual level of knowledge, skills and prior technical education of the trainees;
- the time available for the course;
- the facilities available, e.g. type of simulator.

- **Course outline**

The course outline for the EGOIS training course (Part 8) is composed of:

- a catalogue of the principal EGOIS subjects (training areas),
- an illustration of the interrelationship between the EGOIS subjects, and
- a course timetable on a 1-week basis.

• Syllabus

The detailed teaching syllabus is based on a navigational job analysis in which the navigational functions for making proper use of EGOIS are identified and structured in 17 functional areas (Part G). The syllabus is laid out in learning-objective format. Each objective specifies what the trainee must be able to do as the learning outcome.

• Instructor manual

The instructor manual (Part O) essentially gives information and examples for:

- the preparation of simulator exercises,
- the drawing up of individual lesson plans, and
- guidance on specific subject areas

and describes the importance of:

- teaching (and planning) in a well structured, learning-objective-oriented way,
- theoretical knowledge (of EGOIS data) for safe practical use of EGOIS, and
- the unity of passage planning and passage monitoring.

• Prerequisites for implementation

For the course to be effective and to run smoothly, considerable attention must be paid to thorough preparation and to the availability and use of:

- properly qualified instructors;
- support staff;
- appropriate rooms and other facilities;
- suitable equipment;
- textbooks, technical papers, and other reference material.

The knowledge, skills and dedication of the instructor are the key components in the transfer of knowledge and skills to those being trained by means of IMO model course material.

• Degree of obligation of and freedom from the model course

The model course has been designed to specify clearly the technical content and levels of knowledge and skill necessary to meet the technical intent of IMO conventions and related recommendations. However, it is not the intention of the model course to present instructors with a rigid "teaching package" which they are expected to "follow blindly". Instead, flexibility is necessary. Because educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country, the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms. Moreover, all trainees and the instructor are in an ongoing process of individual and group evaluation. The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied that the trainee has attained each specific learning objective.

- **Potential problems**

The implementation and running of ECOIS training courses may face a couple of specific problems:

- Due to a lack of standardized ECOIS user interfaces, there is considerable product differentiation.
- Trainees on an ECOIS course may have differing experience in the use of chart work, standard navigational procedures and equipment, and in the use of computers including standard MMLs.
- For exercises in real-time navigation, full-mission navigation simulators or multi-mode marine training systems are preferable to stand-alone ECOIS sets, but the facilities of the training institutions might not include such equipment.
- Specific textbooks dealing with ECOIS at the required depth are hardly available at all for the first phase of ECOIS training.

- **Necessary adjustments of the course**

Adjustment of course objectives, scope, content, and time allocation may be necessary in a number of cases as follows:

- Some areas within the detailed syllabus may cause difficulties because the actual trainee entry level differs from that assumed by the course designer.
- In certain maritime areas and professions (e.g. pilots), the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

The instructor should identify all specific differences. To allow training to be effective and to compensate for such differences, the instructor may:

- delete from the course (or reduce the emphasis on) items dealing with knowledge or skills already attained by the trainees; or
- insert elements of academic knowledge required to support the technical training elements at appropriate stages; or
- re-allocate the time required to achieve a specific learning objective; or
- design an appropriate pre-entry course; or
- integrate into an existing training programme the goals and objectives of this model course.

- **Validation**

The information contained in this document has been validated by the Sub-Committee on Standards of Training and Watchkeeping for use by technical advisers, consultants and experts for the training and certification of seafarers so that the minimum standards implemented may be as uniform as possible. "Validation" in the context of this document means that no grounds have been found to object to its content. The Sub-Committee has not granted its approval to the document, as it considers that this work must not be regarded as an official interpretation of the Convention.

Part A: Course Framework

- **Scope**

This course provides training in the basic theory and use of Electronic Chart Display and Information Systems (EGOIS) for those who will be in charge of a navigational watch on vessels equipped with EGOIS. The training comprises all safety-relevant aspects and - for this reason - aims beyond the use of operational controls. Because EGOIS systems and MMIs are in an ongoing process of evolution, a functional approach, not a product-oriented approach, is aimed at. As EGOIS is part of a complex system (including sensors, track control, etc.), complex training based on a variety of functionalities and potential problems is promoted.

The theoretical aspects like all major characteristics of EGOIS data such as data contents and all major characteristics of the display of EGOIS data will be covered in sufficient depth.

For practical capabilities and skills, exercises are performed which will provide practice in setting up and maintaining an EGOIS display, in planning and monitoring a route, in using basic navigational functions and equipment in a real-time navigational environment, in activating updates and in performing proper actions which are necessary for a safe navigational watch.

- **Objective**

A trainee successfully completing this course will be able to use EGOIS for his navigational watch. He will be able to operate EGOIS equipment, use the navigational functions of EGOIS, select and assess all relevant information and take proper action.

The trainee will acquire and develop a knowledge and understanding of the basic principles governing the safe operation of EGOIS, including EGOIS data and their presentation, as well as the system-related limitations and potential dangers.

He will be able to generate and maintain displays, to operate all basic navigational functions and all specific functions for route planning as well as route monitoring, to use and select proper navigational data and to display the data in the appropriate manner. He will also be able to perform updating.

He will be able to analyse nautical alarms during route planning and route monitoring as well as sensor alarms. He will be able to assess the impact of the performance limits of sensors on the safe use of EGOIS and to appreciate that the back-up system is only of limited performance. He will be able to assess errors, inaccuracies and ambiguities caused by improper data management. Thus, he will be aware of errors in displayed data, errors of interpretation and the risk of over-reliance on EGOIS and be able to take proper action.

In addition, he will have knowledge of the principal types of electronic chart and the essential legal aspects of the use of EGOIS.

- **Entry standards**

The course is designated both for candidates for certification as officers in charge of a navigational watch and for experienced nautical officers and other persons with responsible duties in navigation work, such as pilots.

Those wishing to enter this course should have experience in performing chart work and should be able to practise all usual tasks concerning standard navigational procedures and equipment. They should know about the functions and limitations of other navigational equipment.

They should preferably be familiar with standard computer MMIs, including elements such as windows, menus, trackball, etc.

- **Course certificate, diploma or document**

Every master, chief mate and officer in charge of a navigational watch on a ship fitted with ECOIS should have completed a course in the use of ECOIS.

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training which meets or exceeds the level of knowledge and competence specified in Table A-11/1 of STCW Code. A certificate may be issued only by centres approved by the Administration. However, the issuance of a certificate to an officer in charge of a navigational watch, in accordance with regulation 11/1 of the STCW Convention, testifies that the candidate has reached the required level of competence.

- **Course intake limitations**

The course intake will be limited by the availability of equipment such as ECOIS sets, multi-mode marine training systems or full-mission navigation simulators. Experience shows that the efficacy of practical training is optimized when the intake does not exceed three trainees per (standalone) ECOIS set and four trainees on a simulator bridge during exercises in their use. (The duration of complex exercises is up to 5 hours.)

- **Staff requirements**

The qualifications of the instructor should be in accordance with requirements laid down in section A-1/6 of the STCW Code.

He should also be thoroughly familiar with the operation of the equipment to be used in the course.

• Teaching facilities and equipment

For the theoretical part of the syllabus, a classroom equipped with an overhead projector and a blackboard will be required.

For the demonstration of ECDIS features, an ECDIS set with real or simulated sensor input for position, course, speed and depth is required. Own ship must be able to move along the chart. A suitable multi-mode marine training system containing the essential ECDIS features may also be used.

For most practical exercises of the trainees, the equipment should allow a navigational watch as close to reality as possible in real time. A full-mission navigation simulator bridge including an ECDIS set would be desirable.

• Teaching aids (A)

- A1 Instructor Manual (Part D of this Course)
- A2 Video-cassette player
- A3 Video cassettes about the use of ECDIS (if available), e.g. made by independent producers or ECDIS manufacturers
- A4 ECDIS data for an appropriate area
- A5 Simulator for ENC updates (if available)

To be extended whenever suitable teaching aids are available.

• IMO references (R)

- R1 Assembly resolution A.817(19), as amended by resolutions MSC.64(67) annex 5 and MSC.86(70) annex 4, Performance standards for ECDIS
- R2 STCW Convention 1995
- R3 SOLAS chapter V (under revision)
- R4 Resolution A.823(19), Performance standards for ARPA
- R5 Resolution A.477(XII), as amended by resolution MSC.64(67) annex 4, Performance standards for radar equipment
- R6 Resolution A.824(19), Performance standards for devices to indicate speed and distance
- R7 Resolution A.424(XI), Performance standards for gyro-compasses
- R8 Resolution A.819(19), Performance standards for GPS receivers
- R9 Resolution A.224(VII), as amended by resolution MSC.74(69) annex 4, Performance standards for echo-sounding equipment
- R10 Resolution MSC.64(67) annex 3, Performance standards for heading control systems
- R11 Resolution MSC.74(69) annex 2, Performance standards for track control systems
- R12 Resolution MSC.86(70) annex 3, Performance standards for integrated navigation systems
- R13 SN/Circ.207, Differences between RCDS and ECDIS
- R14 Resolution MSC.64(67), Recommendations on new and amended performance standards
- R15 Resolution MSC.86(70), Adoption of new and amended performance standards for navigational equipment.

- **Textbooks and other references (T)**

- T1 IHO Special Publication No.5-52 *Specifications for Chart Content and Display Aspects of ECDIS* (up-to-date edition)
- T2 IHO Special Publication No.5-57 *IHO Transfer Standard for Digital Hydrographic Data* (up-to-date edition)
- T3 Appendix 3 of T1, *Glossary of ECDIS-related terms*
- T4 IEC Publication 61174, Maritime navigation and radiocommunication equipment and systems - Electronic chart display and information system (ECDIS) - Operational and performance requirements, methods of testing and required test results

To be extended whenever suitable textbooks are available .

- **Bibliography (B)**

- B1 N. Bowditch, *The American Practical Navigator*. (Defence Mapping Agency Publication No.9), 1995 edition (chapter 14; pages 219 to 224)

To be extended whenever a more extensive and in-depth bibliography is available.

Part B: Course Outline and Timetable

The course outline for the ECDIS training course is specified by

- a list of the principal ECDIS subjects (training areas) including the area objectives and syllabus outline;
- a flowchart to illustrate the inter-relationships between the principal ECDIS subjects;
- a course timetable (on a 1-week basis).

Part B (1)

List of principal ECDIS subjects (training areas)

Notes:

The area objectives for the principal ECDIS subjects (*written in italics*) are understood to be prefixed by the words "The expected learning outcome is that the trainee is able to ..."

Teaching staff should note that timetables are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual groups of trainees depending on their experience, ability, equipment and staff availability for training.

L = Lecture; D = Demonstration; E = Exercise

Training area	Area objective and syllabus outline	Lessons	L	D	E
1 Legal aspects and requirements	<i>Describe the essential legal aspects and responsibilities in the use of ECOIS</i> Carriage requirements Equivalency Performance standards Data procurement Training requirements	0.5	(0.5	–	–)
2 Principal types of electronic chart	<i>State the main characteristics of principal types of electronic chart (vector and raster)</i>	0.75	(0.75	–	–)
3 ECDIS data	<i>Explain all safety-relevant as well as all other major characteristics of ECOIS data such as data contents, handle ECOIS data on board and assess all errors, inaccuracies, and ambiguities caused by improper data management</i> Terms and definitions Data structure and database ENC creation Data quality Reference systems Data distribution Loading and storing	2.5	(1.5	0.5	0.5)

Training area	Area objective and syllabus outline	Lessons	L	D	E
4 Presentation of ECOIS data	<i>Explain the main characteristics of the display of ECDIS data and select proper information for the navigational tasks</i> Presentation library Modifying the chart presentation Scope and selection of chart data (display categories) Automatic presentation rules Modes of presentation	2.0	(0.75	1.0	0.25)
5 Sensors	<i>Describe the performance limits of sensors and assess their impact on the safe use of ECDIS</i> Performance limits Fall-back sensor systems Data reference system Selection of appropriate and unambiguous sensor data Plausibility of sensor input	1.5	(1.0	0.25	0.25)
6 Basic navigational functions and settings	<i>Operate all basic navigational functions and settings</i> Automatic functions Manual functions Own chart entries Presentation of navigational marks Additional information Vector types	2.75	(0.25	0.5	2.0)
7 Specific functions for route planning	<i>Operate all specific functions and obtain all relevant information for route planning from ECDIS</i> Sea area selection Route planning information Construction of a route Adjustment of a planned route Curved track planning Planning notes Safety values Check for navigational safety Ultimate route	7.5	(0.5	1.0	6.0)
8 Specific functions for route monitoring	<i>Operate all specific functions for route monitoring and obtain all relevant information for navigation and for the ship's safety</i> Monitored area Required route Vector-time Check measurements Look-ahead function Alarms Current and wind	9.5	(0.5	1.0	8.0)
9 Updating	<i>Perform updates and appreciate the importance of updating</i> Production and distribution of updates Manual, semi-automatic and automatic updating Performing updates on board Updating and safe navigation	2.0*	(0.75	0.25	1.0)

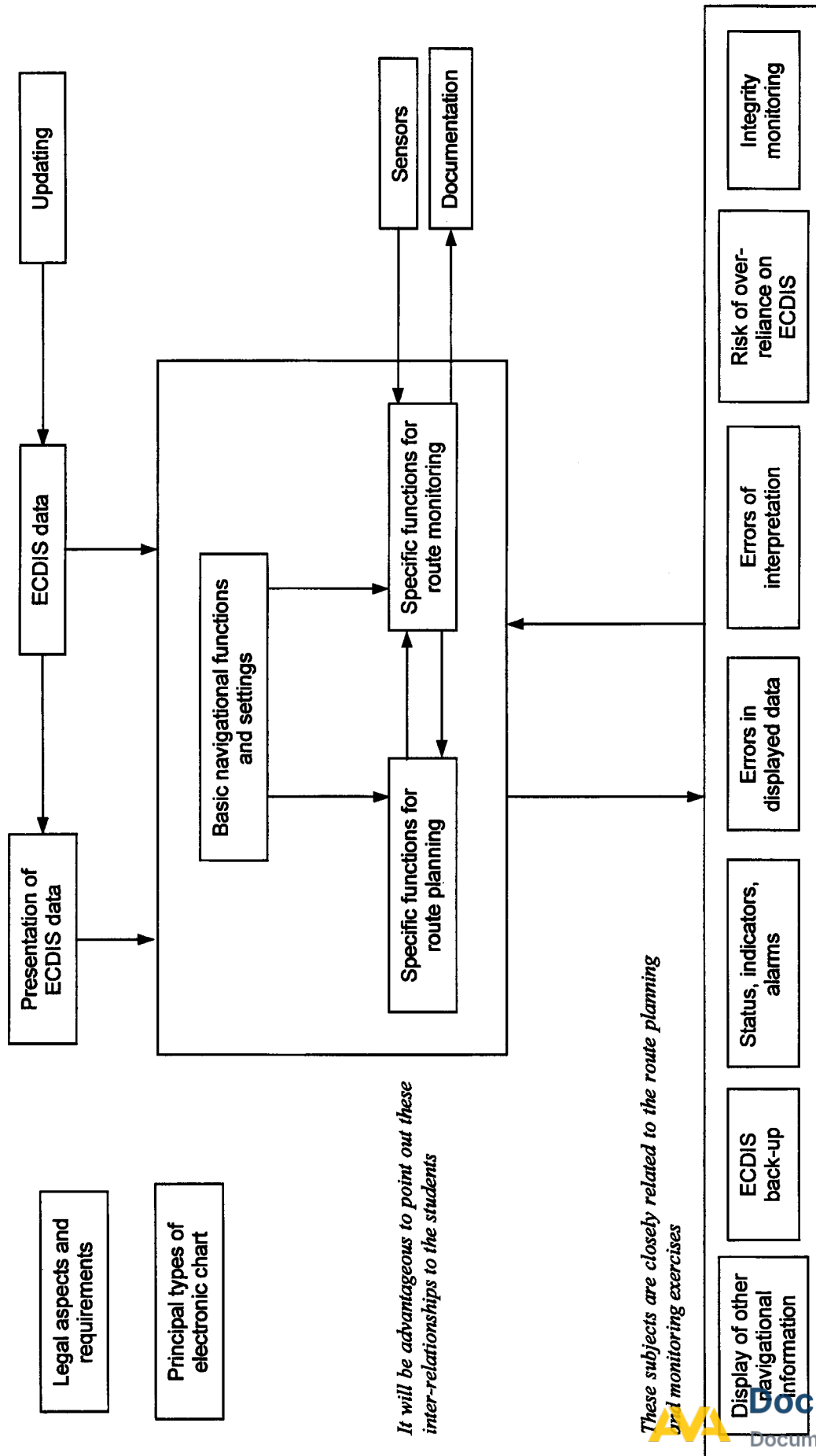
* Depending on the technical realization of updating

PART B: COURSE OUTLINE AND TIMETABLE

Training area	Area objective and syllabus outline	Lessons	L	D	E
10 Display and function of other navigational information	<i>Explain the display and possible dangers and demonstrate the function of other navigational information</i> Radar superimposition Automatic track-keeping Use of transponders	1.75	(0.5	0.75	0.5)
11 Errors in displayed data	<i>Explain the potential errors of displayed data and take proper action</i> Potential errors in the ECDIS display Potential errors in the display of own ship's position Correctness of displayed data	1.5	(0.5	0.5	0.5)
12 Errors of interpretation	<i>Explain the potential errors of interpretation and take proper action to avoid these errors</i>	1.5	(0.5	0.5	0.5)
13 Status indications, indicators and alarms	<i>Explain the status indications, indicators and alarms for different kinds of situation and take proper action</i> Definition and meaning of indicators and alarms Nautical indications/alarms and sensor alarms Data and chart alarms	1.5	(0.5	0.5	0.5)
14 Documentation	<i>Understand the meaning of voyage recording and operate the corresponding functions</i> Automatic voyage recording Reconstruction of past track	0.5	(0.25	0.25	-)
15 Integrity monitoring	<i>Analyse and assess the functioning of EGOIS</i> On-line test Manual and visual tests Verification of proper functioning	1.25	(0.25	0.5	0.5)
16 Back-up	<i>Navigate as safely as possible using the back-up system in the case of an EGOIS failure</i> Takeover by the back-up system Reduced functional capabilities Periodical function test	1.5	(0.25	0.25	1.0)
17 Risk of over-reliance on ECDIS	<i>Assess the limits of EGOIS as a tool which does not release the navigator from proper watchkeeping</i>	1.5	(0.5	0.5	0.5)
Total		40.0	(9.5	8.5	22.0)

Since ECDIS subjects 8, 11, 12, 13, 17 are dealt with simultaneously, it may be impracticable to allocate separate simulator time for these subjects. Instead, a reasonable total time may be allocated to ECDIS subject 8 (Specific functions for route monitoring).

Part B (2): Inter-relationships between principal ECDIS subjects



Part B (3): Proposed Course Timetable "Use of ECDIS"

Day / Session	Day 1	Day 2	Day 3	Day 4	Day 5
Morning	6 (Familiarization) Basic navigational functions/ settings L+D	1 Legal aspects and requirements L	9 Updating L+D+E	13 Status indications, indicators and alarms L+D+E	16 Back-up L+D+E
	6 Familiarization (continued) E	7 Specific functions for route planning (offshore waters) L+D	5 Sensors L+D+E	14 Documentation L+D	17 Risk of over-reliance on ECDIS L+D+E
	2 Principal types of electronic chart L	7 Route planning (offshore waters) E	10 Display of other navigational equipment L+D+E	7 Route planning (coastal waters and approaches) E	7 Route planning (confined waters) E
Afternoon	3 ECDIS data L+D+E	8 Specific functions for route monitoring L+D	11 Errors of displayed data L+D+E	8 Route monitoring (coastal waters and approaches) E	8 Route monitoring (confined waters) E
	4 Presentation of ECDIS data L+D+E	8 Route monitoring (offshore waters) E	12 Errors of interpretation L+D+E	15 Integrity monitoring L+D+E	

Notes

L = Lecture, D = Demonstration, E = Exercise

Total teaching contact time: 40 hours. Short breaks can be taken between the periods as necessary or convenient.

ECDIS subjects 8, 11, 12, 13, 17 are dealt with simultaneously. It may be impractical to allocate separate exercise time to them. Instead, a reasonable total time may be allocated to subject 8.

Additional periods of discussion/workshop can be arranged as necessary or convenient.

The sequence of lessons is essentially based on didactic reasons and on the inter-relations between the subjects stated in the flowchart (Part 8(2)).

Part C: Detailed Teaching Syllabus

The detailed teaching syllabus indicates the contents of the course and appropriate references and teaching aids.

- **Learning objectives**

The detailed teaching syllabus has been written in learning-objective format in which the objective describes what the trainee must do to demonstrate that knowledge has been acquired. All objectives are understood to be prefixed by the words "The expected learning outcome is that the trainee is able to".

- **References and teaching aids**

In order to assist the instructor, references are shown against the learning objective to indicate IMO references and publications, bibliographies, textbooks and other references, as well as additional teaching aids which the instructor may wish to use when preparing course material. The material is listed in the course framework. The following notations and abbreviations are used:

R	IMO references
T	textbook and other references
B	bibliography
A	teaching aids
Ch.	chapter
p.	page
para.	paragraph
Ap.	Appendix

The following are examples of the use of references:

"R1 - para. 1.2" refers to paragraph 1.2 of the annex of Assembly resolution A.817(19) as amended;

"B1 - p. 220" refers to page 220 of the bibliography item *The American Practical Navigator*,

"A1 - Ch. 4.1" refers to chapter 4.1 of the instructor manual (Part O of this course).

- **User manual**

The user manual (Part D) has been used to structure and comment on the detailed teaching syllabus and will provide valuable information to instructors.

Detailed Teaching Syllabus

learning objectives = expected

learning outcomes that

learning objectives	IMO Reference	Bibliography	Teaching Aid
1 Legal aspects and requirements <i>Anta objective: describe the essential legal aspects and responsibilities in the use of ECDIS</i> 1.1 explain (C2) the SOLAS (chapter V) carriage requirements concerning the carriage of charts 1.2 explain (C2) the equivalency of ECDIS and paper charts to make it clear that only ECDIS using the official ENC entitles him to navigate without paper charts 1.3 outline (C1) the IMO performance standards for ECDIS 1.4 explain and accept (C2, A5) his responsibilities with regard to "data procurement" 1.5 explain and accept the training requirements concerning the operation of navigation equipment 2 Principal types of electronic chart <i>Anta objective: state the main characteristics of principal types of electronic chart</i> state (C2): – the differences between different ECDIS systems – the differences between ECDIS and ECS – the differences between vector and raster charts 3 ECDIS data <i>Area objective: explain all safety-relevant as well as all other major characteristics of ECDIS data such as data contents, handle ECDIS data on board and assess all errors, inaccuracies and ambiguities caused by improper data management</i> 3.1 describe (C1) the terms and definitions used in the context of ECDIS, such as S-52, S-57, "object-oriented" data, "vector data", presentation-independence of data, ENC, and SENC 3.2 explain (C2): – the data structure and database of ECDIS, including objects and their attributes (object catalogue) – that the display is a portrait of ECDIS data, i.e. only the information contained and structured in the objects/attributes is available for display – how manual updates are entered in the database 3.3 outline (C1) the steps and responsibilities during ENC creation	R3 R1 - para. 1.2, R2 R1	B1 T1, T2	A1- Ch.4.1 A1- Ch.4.2 A1- Ch.4.3



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Learning objectives	IMO Reference	Bibliography	Teaching Aid
3.4 explain (C2) why chart data quality is dependent on factors such as (survey-) accuracy, updatedness, coverage and completeness of chart data assess (C6) that the data quality is doubtful due to the change of the factors named above 3.5 explain (C2) the different reference systems used for positioning (including time, direction, speed) and associated problems in ECDIS as well as the effects of horizontal and vertical datum assess (C6) all errors, inaccuracies and ambiguities caused by improper data management 3.6 outline (C1) the organization of chart data distribution 3.7 demonstrate (C3) the loading and storing of ECDIS data by calling up the directory of available chart data and by importing the chart data for the waters in question 4 Presentation of ECDIS data <i>Area objective: explain the main characteristics of the display of ECDIS data and select proper information for the navigational tasks</i> 4.1 explain (C2) the major rules for presentation contained in the presentation library for ECDIS apply (C3) the major rules for presentation to the display presentation 4.2 explain (C2) the factors characterizing and modifying the chart presentation, such as projection, colours and symbols as well as data quality such as accuracy, resolution and completeness 4.3 describe (C1) the scope and selection of chart data to be displayed select (C3) the relevant information contents by the display categories "Display base", "Standard display" and "All other information" apply (C3) the different possibilities of selection of the sea area 4.4 outline (C1) the meaning of automatic presentation rules for ECDIS select and apply (C3) appropriate display modes such as: – display category – scale – day or night presentation assess (C6) the resulting differences in information	R1 - para. 3 & Ap.2 R1 - para. 8.1 to 8.4 & Ap. 3 R1 - para. 3.2 & Ap.2 R1 - para. 3.4	81-p.219 T1	A1-Ch. 4.4

Learning objectives	IMO Reference	Bibliography	Teaching Aid
4.5 identify (C1) the different modes of presentation such as: – true or relative motion – north-up or course-up stabilization select and apply (C3) the suitable mode of presentation for the actual situation	R1 - para. 7.1 to 7.3 R1 - para. 7.4		
5 Sensors <i>Area objective: describe the performance limits of sensors and assess their impact on the safe use of ECDIS</i>	R1 - para. 12		A1- Ch.4.5
5.1 explain (C2) the performance limits concerning availability, accuracy and integrity of all navigational sensors connected to ECDIS (Le. devices to determine position, course, speed and depth as well as radar) assess (C6) the impairment of ECDIS performance in the case of a deterioration in sensor performance	R4, R5, R6, R7, RB, R9		
5.2 select and use (C3) an appropriate fall-back sensor system by switching to it or alternatively notice automatic switch-over and use of the fall-back system			
5.3 explain (C2) the data reference system of each connected sensor (e.g. geodetic system, position of antenna and transducer)			
5.4 explain (C2) the need for selection of appropriate and unambiguous sensor data displayed in ECDIS			
5.5 assess (C6) the plausibility of sensor input values to ECDIS			
6 Basic navigational functions and settings <i>Area objectives: operate all basic navigational functions and settings</i>	R1-Ap.3		A1- Ch.4.6
6.1 identify (C1) all automatic functions required for monitoring ship's safety such as the display of position, heading/gyro course, speed, safety values and time	R1 -Ap. 3		
6.2 demonstrate (C3): – how manual functions and elements such as cursor, electronic bearing line and range rings are used – how a position which was not automatically determined is marked on the ECDIS display – how position-fixing methods are applied within ECDIS (line of position) – how the range scale and/or the scale is changed, how own ship's safety values such as "safety contour" or "safety depth" are set	R1 - para. 10.5.11 & Ap.3 R1 - para. 3.6 & 3.7		
6.3 demonstrate (C3): – how own chart entries like "Mariner's notes" or events are applied – how own chart entries are removed			

Learning objectives	IMO Reference	Bibliography	Teaching Aid
6.4 demonstrate (C3) how the presentation of navigation marks is changed			
6.5 demonstrate (C3): – how additional information on particular ENC objects such as lights are switched on for display – how depth values and spot soundings are picked			
6.6 demonstrate (C3) the two vector types indicating the ship's motion over ground and through the water and their benefits and drawbacks			
7 Specific functions for route planning <i>Area objective: operate all specific functions and obtain all relevant Information for route planning from ECDIS</i>	R1 - para. 10.4		A1- Ch.4.7
7.1 demonstrate (C3) how the sea areas and the required waters for planning the whole passage are selected for display			
7.2 demonstrate (C3): – how relevant route planning information such as sailing directions, tidal or meteorological information is gained from ECOIS and other sources – how information required for specific situations such as anchoring is obtained			
7.3 demonstrate (C3) how the construction of a route is performed by the input of waypoints, both directly on the ECOIS display and alphanumerically	R1 - para. 10.4.1		
7.4 demonstrate (C3) how the adjustment of a planned route by editing waypoints is performed	R1 - para. 10.4.2		
7.5 demonstrate (C3): – how curved track planning is performed by the input of turning radii, wheel-over points/lines and safe speeds – how courses and distances of the track are obtained from the chart by different methods such as cursor position, selection of legs or recalling the waypoint list – how time marks are set – how track limits are set	R1 - para. 10.4.1 R1 - para. 10.4.6		
7.6 demonstrate (C3): – how planning notes such as courses, rudder angles and speeds to be maintained in a specific area are applied – how expected passage times are determined – how current is to be considered when plotting a track in the ECOIS display			
7.7 assess (C6) which safety values are to be selected in accordance with the ship's dimensions and the manoeuvring parameters to be applied	R1 - para. 10.4.4		
7.8 demonstrate (C3) how a planned route is checked for navigational safety	R1 - para. 10.4.4 & 10.4.5 & Ap. 4		



Learning objectives	IMO Reference	Bibliography	Teaching Aid
7.9 assess (C6): – if a track is reliably safe by considering all predictable hazards along it – which ultimate route is to be taken – which points/areas are critical 8 Specific functions for route monitoring <i>Area objective: operate all specific functions for route monitoring and obtain all relevant Information for navigation and for the ship's safety</i> 8.1 demonstrate (C3) how a monitored area is selected. left and returned to 8.2 demonstrate (C3) how the required route is selected, called up and, if necessary, modified 8.3 demonstrate (C3) how a predicted position can be generated by setting a "vector-time" and explain (C2) the relevance of "vector-time" information 8.4 demonstrate (C3) how check measurements of the ship's position, independent of the ECDIS equipment including its sensors, are performed and plotted in ECDIS 8.5 explain (C2) the relevance of the "look-ahead function" and demonstrate (C3) how the "look-ahead function" is performed 8.6 explain (C2) how the alarms concerning route monitoring are triggered, e.g. – by crossing a safety contour or prohibited area – by violation of the set limits for deviation from on arrival at a critical point of the route demonstrate (C3) how alarms are set with regard to their presentation and their alarm levels assess (C6) the significance of the different alarms concerning route monitoring 8.7 demonstrate (C3) how values for current and wind which are obtained from external sources are applied to ECDIS 9 Updating <i>Area objective: apply updates and assess the Importance of updating</i> 9.1 outline (C1): – how the production of updates by national hydrographic services is performed – how the distribution of updates by regional data centres is organized and executed 9.2 explain (C2) the essentials of manual, semi-automatic and automatic updating	R1 - para. 10.5 R1 - para. 10.5.2 R1 - para. 10.5.1 & 10.5.10 R1 - para. 10.5.11 R1 - para. 10.5.3 to 10.5.9 & Ap. 4 & 5 R1 - para. 4		A1- Ch.4.8 A1- Ch.4.9



Learning objectives	IMO Reference	Bibliography	Teaching Aid
9.3 perform (C3) updates on board by: - performing (C3) the manual and semi-automatic updating procedures - indicating (C3) how items which are added to, removed from or altered on the original ENC are marked and indicated - displaying updates in order to: - review their contents and - ascertain that they have been included in the SENC	R1 - para. 4.8		
9.4 realize (A1) that only continuously updated data allow safe navigation			
10 Display and function of other navigational information <i>Area objective: explain the display and possible dangers and demonstrate the function of navigational information</i>	R1 - para. 6		A1- Ch.4.10
10.1 demonstrate (C3) how radar superimposition is employed explain (C 2) and assess (C6) possible offsets of radar echoes of fixed charted objects from their charted position	R3,R4		
10.2 indicate (C3) how automatic track-keeping is employed describe (C1) the potential dangers of the automatic track-keeping mode	R10, R11		
10.3 demonstrate (C3) the use of information from transponders			
11 Errors of displayed data <i>Area objective: explain the potential errors of displayed data and take proper action</i>			A1- Ch. 4.11
11.1 explain (C2) the potential errors of the ECOIS display due to: - inaccurate hydrographic data - poor resolution - the shifting of buoys	R1-para.11		
11.2 explain (C2) that potential errors introduced by: - inaccurate input from the electronic position-fixing system - inaccurate input of radar data - different geodetic co-ordinate systems - reference position of sensors on board may result in errors in the display of own ship's position	R1 - para. 12		
11.3 check (C6) the correctness of displayed data: - by comparing ECOIS and radar information - by checking the ship's position by means of a second independent position-fixing system			
12 Errors of interpretation <i>Area objective: explain the potential errors of interpretation and take proper action to avoid these errors</i>			A1- Ch.4.12

Learning objectives	IMO Reference	Bibliography	Teaching Aid
Explain (C2) the errors of interpretation due to: - different modes of vector stabilization - overscale of the display - neglecting the 95% probability of the accuracy standard of the fixing sensor - automatic track-keeping features such as the continuous display of own ship's position on the preplanned track - difference between true north and gyro north (radar) avoid (C6) errors of interpretation by verifying the selection of: - a common reference system - the appropriate scale - the sensors best suited for the given situation - the safety values - display categories - usage, etc.	R1 - para. 5 R8		
13 Status Indications, Indicators and alarms <i>Area objectives: explain the status indications, indicators and alarms for different kinds of situation and take proper action</i> 13.1 outline (C1) the definition and meaning of status indications, indicators and alarms related to ECDIS, including the areas for which ECDIS should provide an alarm or indication 13.2 explain (C2) and analyse (C4): - the nautical indications during route planning - the nautical alarms during route monitoring - the sensor alarms and indications, and apply (C3) appropriate measures in the case of their occurrence 13.3 explain (C2) and analyse (C4) the data and chart alarms, resulting from a non-WGS 84 geodetic datum or overscale setting	R1 - Ap. 5 & Ap.4 R1 - para. 10.4.5 & 10.5.4 R1 - para. 5		A1- Ch.4.13
14 Documentation <i>Area objective: understand the meaning of voyage recording and operate the corresponding functions</i> 14.1 outline (C1) the essentials of automatic voyage recording 14.2 demonstrate (C3): - how the contents of automatic voyage recording are called up, in particular: - how a past track is constructed and - how the database in use is verified - how possible selections of, for example, recording media or recording intervals are carried out	R1 - para. 10.6		A1- Ch.4.14
15 Integrity monitoring <i>Area objective: analyse and assess the proper functioning of ECDIS</i> 15.1 outline (C1): - the proceeding of the on-line test during booting - the on-line system check during normal operation		T4	A1- Ch.4.15

Learning objectives	IMO Reference	Bibliography	Teaching Aid
15.2 perform (C3): – manual tests of the major functions of hardware, MMI and sensor data – visual tests of chart data 15.3 recognize (C3) all status indications verify (C3): – the proper functioning of the ECDIS display and the position-fixing system by comparing ECDIS and radar objects or back-up positioning system – that all received updates are contained in the ECDIS display assess (C6) that the navigation process is safe	R1 - para. 13		
16 Back-up <i>Area obJective: navigate as safely as possible using the back-up system In the case of an ECDIS failure</i>	R1 - para. 14		A1- Ch.4.16
16.1 perform (C3): – a safe takeover by the back-up system – a safe transfer of all relevant passage planning data from the ECDIS to the back-up system – a transfer of all relevant updates immediately to the back-up system	R1 -Ap. 6		
16.2 explain (C2) the reduced functional capabilities which are available with the back-up system appreciate (C6) that the back-up system is only of limited performance and that the back-up system should be replaced by a properly functioning ECDIS as soon as possible			
16.3 explain (C2) that periodical function tests and practice of the takeover procedure are necessary in order to verify proper functioning of the back-up device in an emergency case			
17 Risk of over-reliance on ECCIS <i>Area obJective: assess the limits of ECDIS as a tool which does not release the navigator from proper watchkeeping</i> recognize (A1): – that a potential risk of improper functioning of the system and of data inaccuracy is inherent in the system – that the displayed hydrographic data are not more reliable than the survey data on which they are based – that the displayed sensor data are not more reliable than the respective sensor systems they originate from – that ECDIS is only a tool that supports the mariner in the performing of the navigational tasks – that errors/inaccuracies in one subsystem may influence the performance of other subsystems and potentially render the ECDIS useless			A1- Ch.4.17