

**MODEL  
COURSE  
7.02**

**CHIEF ENGINEER  
OFFICER AND  
SECOND ENGINEER  
OFFICER**

**2014 EDITION**

**MODEL COURSE 7.02**

**CHIEF ENGINEER OFFICER  
AND SECOND ENGINEER  
OFFICER**

2014 EDITION



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# Foreword

Since its inception the International Maritime Organization (IMO) 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 administrations, ports, shipping companies and maritime training institutes by establishing the World Maritime University in Malmö, Sweden, in 1983.

Following the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW), 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 implementation of 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. With the generous assistance of the Government of Norway, IMO developed model courses in response to these generally identified needs and now keeps them updated through a regular revision process taking into account any amendments to the requirements prescribed in IMO instruments and any technological developments in the field.

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

K. SEKIMIZU  
Secretary-General

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# Introduction

## ■ Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff to introduce and organize new training courses and enhance existing training material, whereby the quality and effectiveness of the training may be improved.

It is not the intention of the model course programme to present instructors with a rigid “teaching package” which they are expected to “follow blindly”. Nor is it the intention to substitute audio-visual or “programmed” material for the instructor’s presence. As in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

Rather, this document should be used as a guide with the course duration given as indicative of the expected time required to cover the required outcomes. The parties may modify this course to suit their respective training schemes.

For those following planned training schemes approved by the Administration, it is intended that this training may form an integral part of the overall training plan and be complementary to other studies. The training may be undertaken in progressive stages; for such candidates, it is not appropriate to specify the duration of the learning, provided achievement of the specified learning outcomes is properly assessed and recorded.

The educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country. For this reason, the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the technical intent of IMO conventions and related recommendations.

This is the first major revision to this model course. In order to keep the training programme up to date in future, it is essential that users provide feedback. New information will provide better training in safety at sea and protection of the marine environment. Information, comments and suggestions should be sent to the Head of the Maritime Training and Human Element Section at IMO, London.

## ■ Use of the model course

To use the model course, the instructor should review the course plan and detailed syllabus taking into account the information provided under the entry standards specified in the course framework. The actual level of knowledge and skills and the prior technical education of the trainees should be kept in mind during this review, and any areas within the detailed syllabus which may cause difficulties because of differences between the actual trainee entry level and that assumed by the course designer should be identified. To compensate for such differences, the instructor is expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. He should also identify any academic knowledge, skills or technical training which they may not have acquired.



By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an appropriate pre-entry course or, alternatively, insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the technical course.

Adjustment of the course objective, scope and content may also be necessary if in your maritime industry the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the course plan, the course designers have indicated their assessment of the time that should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and do not indicate a minimum or maximum number of hours and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments and may need to re-allocate the time required to achieve each specific learning objective or training outcome.

## ■ Lesson plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. Where no adjustment has been found necessary in the learning objectives of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making his presentation of the material.

## ■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied, by testing and evaluating the trainee's performance and achievements, that the trainee has attained each specific learning objective or training outcome. The syllabus is laid out in learning objective format and each objective specifies a required performance or what the trainee must be able to do as the learning or training outcome. Taken as a whole, these objectives aim to meet the knowledge, understanding and proficiency specified in the appropriate tables of the STCW Code.

## ■ Implementation

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

- properly qualified instructors
- support staff
- rooms and other spaces
- workshops and equipment
- suggested references, textbooks, technical papers, bibliography
- other reference material.

Thorough preparation is the key to successful implementation of the course. IMO has produced a booklet entitled Guidance on the implementation of IMO model courses, which deals with this aspect in greater detail.

In certain cases, the requirements for some or all of the training in a subject are covered by another IMO model course. In these cases, the specific part of the STCW Code, which applies, is given and the user is referred to the other model course.

## ■ **Course objective**

This model course comprises four functions at the management level. On successful completion of the course and the requisite watchkeeping experience, officers will be prepared for taking full responsibility for the safety of the ship, its passengers, crew and cargo. They will be aware of their obligations under international agreements and conventions concerning safety and the protection of the marine environment and will be prepared for taking the practical measures necessary to meet those obligations.

In this model course, one combined course has been written for both chief engineer officer and second engineer officer. The material is set out so that it can be run separately from the course for officer in charge of an engineering watch, but this is not intended to imply that it has to be run separately. It has been written in this manner so as to give Administrations the opportunity to arrange a structure best suited to their needs.

The teaching schemes should be carefully scrutinized to ensure that all of the tabulated training outcomes are covered, that repetition is avoided and that essential underpinning knowledge at any stage has already been covered. A certain amount of duplication under different subjects will probably occur, provided it is not excessive, the different approaches can provide useful reinforcement of work already learned. Care should be taken to see that items not included in the syllabus or treatment beyond the depth indicated by the objectives have not been introduced except where necessary to meet additional requirements of the Administration. The teaching scheme should be adjusted to take account of those matters and the timing of any modular courses (such as training in firefighting), that are to be included.

## ■ **Entry standards**

Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of an engineering watch in a manned engine-room or designate duty engineer in a periodically unmanned engine-room (see IMO model course 7.04, Officer in charge of an engineering watch).

## ■ **Course intake limitations**

Class sizes should be limited to not more than 24 in order to allow the instructor to give adequate attention to individual trainees. Larger numbers may be admitted if extra staff and tutorial periods are provided to deal with trainees on an individual basis. In addition, for scheduling access to learning facilities and equipment, attention to strict time management is necessary. In large classes students should have their own reference books, unless sufficient

copies can be provided in a central library. Classrooms should be big enough to seat all students so they can see and hear the instructor.

During practical sessions and group activities, there will be additional restraints on class size. Where applicable, a recommendation on class size is contained in the framework for each of the individual functions.

## ■ Textbooks, videos and bibliography

References to books, videos and bibliography are made in the Instructor Manual of the individual subjects to aid both instructors and trainees in finding relevant information and to help in defining the scope and depth of treatment intended.

The mention of a particular textbook does not imply that it is essential to use that book, only that it appeared to be best suited to the course at the time of its design. In many instances there are a number of suitable books, and instructors are free to use whatever texts they consider to be most suited to their circumstances and trainees.

Every effort has been made to quote the latest editions of the publications mentioned but new editions are constantly being produced. Instructors should always use the latest edition for preparing and running their courses.

Full use should be made of technical papers and other publications available from maritime and other professional organizations. Such papers contain new developments in techniques, equipment, design, management and opinion, and are an invaluable asset to a maritime training establishment.

## ■ Computer applications

In view of the rapid growth of information technology (IT) and widespread use of computers aboard ship, it is recommended that at the discretion of the Administration, computer applications at an advanced level should be included in the training for chief engineer officer and second engineer officer. If this topic has not been covered during training as officer in charge of an engineering watch some basic training will also be required.

Particulars of the training will depend upon the computer facilities available and the needs of the trainees. The following outline provides guidance on topics that could be included:

- care and storage of magnetic media; use of simple utility programs for identifying disk problems and fixes; LAN maintenance; back-up management; virus protection
- IT and the use of applications, for communications (email, data, etc.), the internet, intranets and the worldwide web (www)
- installation and set-up of multi-media applications.

In addition, applications of computers and micro-processors to instrumentation and control systems, including:

- simple digital circuits, binary logic switches, bi-stable circuits

- logic gates, truth tables of simple logic circuits
- representation of data by bits, bytes and words, binary and hexadecimal representation
- binary-coded decimal representation, fixed- and floating-point numbers, ASCII Code
- analog to digital and digital to analog converters
- computer architecture, information transfer between principal units
- memory, ROM, RAM, direct access memory, virtual memory
- input and output devices, data transfer, modems, multiplexers
- block diagrams of computer supervisory control systems and direct digital control systems
- automatic monitoring, data-recording and alarm systems.

The use of multi-media applications can enhance learning in topics in many areas of knowledge and prove of value to chief engineer officer and second engineer officer. Many of the IMO rules and Assembly resolutions are available on CD-ROM. Up-to-date details may be found on the IMO website at <http://www.imo.org>

## ■ **Training and the STCW Convention 1978, as amended**

The standards of competence that have to be met by seafarers are defined in part A of the STCW Code in the Standards of Training, Certification and Watchkeeping for Seafarers Convention, 1978, as amended. This IMO model course has been revised and updated to cover the competences in STCW Code. It sets out the education and training to achieve those standards.

In common with the Convention, the course is organized under the seven functions at three levels of responsibility. Specifically, this course covers the minimum standard of competence for chief engineer officers and second engineer officers on ships powered by main propulsion machinery of 3,000 kW propulsion power or more, see STCW Code, table A-III/2.

For ease of reference, the course material is organized in four separate functions as per the STCW Code. These functions are:

- Function 1    Marine engineering at the management level
- Function 2    Electrical, electronic and control engineering at the management level
- Function 3    Maintenance and repair at the management level
- Function 4    Controlling the operation of the ship and care for the persons on board at the management level

Each function is addressed in five parts: Part A which is common for all functions, Part B, Part C, Part D and Part E, which again addresses all the functions.

Part A provides the framework for the course with its aims and objectives and notes on the suggested teaching facilities and equipment. A list of useful teaching aids, videos, CBTs, IMO references, textbooks and bibliography is included, which affects all four functions.

Part B provides an outline of lectures, demonstrations and exercises for the course. No detailed timetable is suggested. From the teaching and learning point of view, it is more important that the trainee achieves the minimum standard of competence defined in the STCW Code than that a strict timetable is followed. Depending on their experience and ability, some students will naturally take longer to become proficient in some topics than in others.

Part C gives the Detailed Teaching Syllabus. This is based on the theoretical and practical knowledge specified in the STCW Code. It is written as a series of learning objectives; in other words what the trainee is expected to be able to do as a result of the teaching and training. Each of the objectives is expanded to define a required performance of knowledge, understanding and proficiency. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Part D gives the Instructor Manual, which contains guidance notes for the instructors and additional explanations. Suggested teaching aids, videos, CBTs, IMO references, textbooks and bibliography are included to assist the teacher in preparing and presenting their lessons.

Thus, each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the *required performance* expected of the trainee in the tables that follow.

## ■ Responsibilities of Administrations

Administrations should ensure that training courses delivered by approved training institutions are such as to ensure officers completing training do meet the standards of competence required by STCW regulation III/2, paragraph 2.

## ■ 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 approved this document, as it considers that the document must not be considered an official interpretation of the Convention.

## ■ Conventions, Regulations and Legislation

These are constantly being revised and updated. It is essential that the up-to-date version of these are being used and that all references to particular versions in this model course should be taken to include all future amendments and revisions.



## Part A: Course Framework for all functions

### ■ Aims

This model course aims to meet the mandatory minimum requirements for knowledge, understanding and proficiency in table A-III/2 of STCW Code for the function Marine Engineering at the Management Level, for the function Electrical, Electronic and Control Engineering at the Management Level, for the function Maintenance and Repair at the Management Level and the background knowledge to support Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

### ■ Objective

#### Function 1

The syllabus covers the requirements of the 2010 STCW Convention, chapter III, section A-III/2. This functional element provides the detailed knowledge to support the training outcomes related to Marine Engineering at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- managing the operation of propulsion plant machinery
- planning and scheduling operations *Theoretical knowledge*
- operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery *Practical knowledge*
- managing fuel, lubrication and ballast operations.

#### Function 2

The syllabus covers the requirements of the STCW Convention, chapter III, section A-III/2. This functional element provides the detailed knowledge to support the training outcomes related to Electrical, Electronic and Control Engineering at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- managing operation of electrical and electronic control equipment *Theoretical knowledge*
- managing troubleshooting and restoration of electrical and electronic control equipment to operating condition *Practical knowledge*

#### Function 3

The syllabus covers the requirements of the STCW Convention, chapter III, section A-III/2. This functional element provides the detailed knowledge to support the training outcomes related to Maintenance and Repair at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- managing safe and effective maintenance and repair procedures
- detecting and identifying the cause of machinery malfunctions and correct faults  
*Practical knowledge*
- ensuring safe working practices *Practical knowledge*.

#### **Function 4**

The syllabus covers the requirements of the STCW Convention, chapter III, section A-III/2. This functional element provides the detailed knowledge to support the training outcomes related to Controlling the Operation of the Ship and Care for Persons on Board at the Management Level.

This section provides the background knowledge to support the tasks, duties and responsibilities in:

- controlling trim, stability and stress
- monitoring and controlling compliance with legislation to ensure safety of life at sea and protection of the marine environment
- maintaining safety and security of crew and passengers and the operational condition of safety systems
- developing emergency and damage control plans and handling emergency situations
- using leadership and managerial skills.

These include topics such as ship construction and stability, search and rescue, personnel management and contingency planning.

### **■ Entry standards**

This course is principally intended for officers for certification as chief engineer and second engineer on ships powered by main propulsion machinery of 3000 kW propulsion power or more. Entrants should have successfully completed a course covering the minimum standards required for certification as officer in charge of an engineering watch (see IMO model course 7.04, Officer in charge of an engineering watch) and have approved seagoing service (see STCW regulation III/2). For those officers who want to take up the steam propulsion module it is recommended that they have practical experience onboard steam powered vessels.

### **■ Course certificate**

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-III/2 of STCW Code, for the function.



A certificate may be issued only by centres approved by the Administration.

## ■ Staff requirements

Instructors shall be qualified in the task for which training is being conducted and have appropriate training in instructional techniques and training methods (STCW Code, section A-I/6). As well as instructors, additional staff will be required for the maintenance of machinery and equipment and for the preparation of materials, work areas and supplies for all practical work.

## ■ Teaching facilities and equipment

A classroom equipped with appropriate teaching facilities should be provided for teaching the theory of the course and holding group discussions.

Administrations may wish to consider the provision of a large workshop, equipped to facilitate all of the engineering practice, in a single space. Such an arrangement can be quite efficient in the use of staff, materials, stores, tools, etc.

## ■ Teaching aids (A)

The list of teaching aids and references are recommendations only and are intended to support the learning outcomes of the course.

- A1 Instructor Manual (Part D of this course)
- A2 Ship's Drawings/Plan (GA, Shell expansion, Deck plan and Mid section)
- A3 Videos (DVDs), CD-ROMs, CBT's (V)
  - V1 DIESEL ENGINE CRANKCASE LUBRICATING OILS Code No. 126
  - V2 HANDLING & TREATMENT OF HEAVY FUELS Code No. 143
  - V3 INTERNAL CARE OF MARINE BOILERS Code No. 150
  - V4 HYDRAULIC OIL CONTAMINATION Code No. 166
  - V5 DIESEL FUEL INJECTION PUMPS Code No. 302
  - V6 MICROBIAL PROBLEMS IN FUELS Code No. 322
  - V7 PRINCIPLES OF LUBRICATION & GENERAL APPLICATION Code No. 442
  - V7A LUBRICATION, SLOW & MEDIUM SPEED MARINE DIESEL ENGINES Code No. 443
  - V8 LUBRICATION OF ANCILLARY EQUIPMENT – PART 3 Code No. 444
  - V9 MACHINERY ALARMS & PROTECTION DEVICES Code No. 528
  - V10 FUEL OIL BURNER THEORY AND DIAGNOSTICS Code No. 604
  - V11 AN INTRODUCTION TO HYDRAULICS Code No. 66
  - V12 EFFICIENT OPERATION OF MARINE DIESEL ENGINES Code No. 693
  - V13 SHIP'S ELECTRICAL SYSTEMS – SAFETY AND MAINTENANCE Code No. 665
  - V14 ELECTRICAL DISTRIBUTION Code No. 666
  - V15 GENERATORS AND MAIN CIRCUIT BREAKERS Code No. 667
  - V16 MOTORS AND STARTERS Code No. 668
  - V17 ANCILLARY ELECTRICAL SERVICES Code No. 669
  - V18 SPECIAL ELECTRICAL PRACTICE FOR OIL, GAS & CHEMICAL TANKERS Code No. 670
  - V19 ELECTRICAL SURVEY REQUIREMENTS Code No. 671

- V20 ELECTRIC PROPULSION AND HIGH VOLTAGE PRACTICE Code No. 672
- V21 MARPOL ANNEX VI – PREVENTION OF AIR POLLUTION FROM SHIPS (Ed Code No. 1119
- V22 FIGHTING POLLUTION – PREVENTION OF POLLUTION FROM SHIPS EDIT Code No. 1122
- V23 CRISIS MANAGEMENT Code No. 507
- V24 FIRE PARTY OPERATIONS Code No. 509
- V25 THE INTERNATIONAL SAFETY MANAGEMENT CODE Code No. 524
- V26 LOAD LINE SURVEYS – PART 1 Code No. 544
- V27 SAFETY CONSTRUCTION SURVEY – PART 2 Code No. 545
- V28 SAFETY EQUIPMENT SURVEY – PART 3 Code No. 546
- V29 PERSONAL SAFETY IN THE ACCOMMODATION Code No. 554
- V30 PERSONAL SAFETY ON DECK Code No. 555
- V31 PERSONAL SAFETY IN THE ENGINE ROOM Code No. 556
- V32 PERSONAL SAFETY ON BULK CARRIERS Code No. 558
- V33 PERSONAL SAFETY ON GENERAL CARGO SHIPS Code No. 559
- V34 PERSONAL SAFETY ON CONTAINER SHIPS Code No. 560
- V35 PERSONAL SAFETY ON CAR CARRIERS & ROROS Code No. 562
- V36 PERSONAL SAFETY ON PASSENGER SHIPS Code No. 563
- V37 THE SHIPBOARD MANAGEMENT ROLE (EDITION 2) Code No. 969
- V38 PERSONAL SAFETY ON TANKERS (EDITION 2) Code No. 970
- V39 PERSONAL SAFETY ON CHEMICAL TANKERS Code No. 980
- V40 THE ISM AUDIT Code No. 575
- V41 BUNKERING OPERATIONS – SAFE OIL TRANSFER PROCEDURES Code No. 588
- V42 MARINE RISK ASSESSMENT – THE FLEET Code No. 735
- V43 MANAGEMENT ON BOARD – PART 1 Code No. 607
- V44 GET SMART: ORGANISATION AND PLANNING – PART 2 Code No. 608
- V45 GET RESULTS: PLANNING FOR PROFIT – PART 3 Code No. 609
- V46 TEAMWORK – PART 4 Code No. 610
- V47 MOTIVATING INDIVIDUALS – PART 5 Code No. 611
- V48 COMMUNICATION – PART 6 Code No. 612
- V49 PERMIT TO WORK Code No. 621
- V50 SEVEN STEPS TO SHIP STABILITY PART 1 Code No. 622
- V51 SEVEN STEPS TO SHIP STABILITY PART 2 Code No. 623
- V52 WASTE AND GARBAGE MANAGEMENT Code No. 627
- V53 MACHINERY SPACE FIRES (EDITION 3) Code No. 677
- V54 ENCLOSED LIFEBOATS, FREEFALL LIFEBOATS RESCUE BOATS Code No. 679
- V55 ENTERING INTO ENCLOSED SPACES (EDITION 2) Code No. 682
- V56 OPERATIONS & PERSONAL SAFETY IN DRY-DOCKS & REPAIR YARDS Code No. 692
- V57 BALLAST WATER MANAGEMENT Code No. 698
- V58 CREW RESOURCE MANAGEMENT – ENGINE ROOM Code No. 929