Introduction

Purpose of the model courses

The purpose of the IMO model courses is to assist organizations that focus on maritime training with the development and introduction of new training courses. This also includes the updating and improvement of existing courses so that the quality and effectiveness of seafarers' training may be consistent internationally.

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 audiovisual or programmed material for the instructor's presence.

As in all training endeavours, the knowledge, skills and dedication of instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

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, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the intent of IMO conventions and related recommendations.

Use of the model course

To use the model course, instructors should review the General outline and Detailed outline, 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, instructors are expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. Instructors should also identify any academic knowledge, skills or technical training which they may not have acquired.

By analysing the general outline and the academic knowledge required to allow training in the technical area to proceed, instructors 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 objectives, scope and content may also be necessary if in the national maritime industry the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the General outline (part B), the course designers have indicated their assessment of the time that should be allotted to each learning area. However, it must be appreciated that these allocations assume that the trainees have fully met all entry requirements of the course. Instructors should therefore review these assessments and may need to reallocate the time required to achieve each specific learning objective.

Lesson plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, instructors should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed for use in the course. 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 instructors in the presentation of the material.

Presentation

The presentation of concepts and methodologies must be repeated in various ways until instructors are satisfied that the trainee has attained each specified learning objective. The Detailed outline (part C) is laid out in learning-objective format and each objective specifies what the trainee must be able to do as the learning outcome.

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;
- relevant support staff;
- teaching and other spaces;
- appropriate equipment and teaching aids;
- videos and multi-media presentations;
- textbooks, appropriate technical papers, etc.; and
- other relevant reference material.

Thorough preparation is the key to successful implementation of the course. IMO has produced *Guidance on the implementation of IMO model courses*, which deals with this aspect in greater detail and is included as an appendix to this course.

Training and the STCW Convention

The standards of competence that have to be met by seafarers are defined in part A of the STCW Code in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), 1978, as amended. This IMO model course addresses the competences and the training that is required to achieve the standards for the knowledge, understanding and proficiency (KUPs) set out in table A-III/7 of the STCW Code.

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, IMO references and textbooks is also included.

Part B provides an outline of lectures, demonstrations and exercises for the course. Also included in this section are guidance notes and additional explanations.

A separate IMO model course (3.12) addresses assessment of competence. This course explains the use of various methods for demonstrating competence and criteria for evaluating competence as tabulated in the STCW Code.

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 learning experience. Each of the objectives is expanded to define a required performance of knowledge, understanding and proficiency. IMO references, textbook references and suggested teaching aids are included to assist instructors in designing lessons.

The new training requirements for these competences are addressed in the appropriate parts of the detailed teaching syllabus.

Part D gives guidance notes and additional explanations to instructors on the topics and learning outcomes listed in Part C. For the various topics, this part presents subject matter details, activities and recommended presentation and assessment techniques.

Part E presents a generic guide for effective evaluation/assessment of trainees. Parts C and D of this model course address the generic subject matter of part E in greater detail.

Validation

The guidance contained in this document has been validated by the Sub-Committee on Human Element, Training and Watchkeeping for use by Administrations and training providers in developing relevant training programmes for the effective implementation of uniform minimum standards for training and certification of seafarers. Validation in this context means that the Sub-Committee has found no grounds to object to the contents of this model course, but has not granted its approval to the document, as the Sub-Committee does not consider any model course to be an official interpretation of IMO instruments.

Part A: Course framework

Aim

The aim of this model course is to meet the mandatory minimum standards of competence for seafarers as electro-technical ratings, for the functions: electrical, electronic and control engineering; maintenance and repair; and controlling the operation of the ship and care for persons on board, at the support level specified in table A-III/7 of the STCW Code.

Objectives

The objective is to provide trainees with guidance and information to gain knowledge, understanding and proficiency (KUP) required to achieve the objectives of the learning outcomes to demonstrate the standard of competence for Electro-Technical Rating set out in table A-III/7 of the STCW Code.

Specifically at the end of the course, the trainees should be able to successfully demonstrate their competence at the support level in the following functions:

Function 1: Electrical, electronic and control engineering

- safe use of electrical equipment;
- contribute to monitoring the operation of electrical systems and machinery; and
- use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations.

Function 2: Maintenance and repair

- contribute to shipboard maintenance and repair; and
- contribute to the maintenance and repair of electrical systems and machinery on board.

Function 3: Controlling the operation of the ship and care for persons on board

- contribute to the handling of stores;
- apply precautions and contribute to the prevention of pollution of the marine environment; and
- apply occupational health and safety procedures.

Entry standards

Entry standards should be in accordance with the STCW Convention or other applicable IMO instruments, where such requirements are specified. If such requirements are not specified, it is left to the Administration to decide entry standards in accordance with national regulations and system of education.

Course certificate

On successful completion of the requirements of the course, a certificate of completion may be issued as evidence of achieving the mandatory minimum requirements in accordance with STCW regulation III/7 and the standard of competence in section A-III/7 of the STCW Code, for the issuance by the Administration of the appropriate certificate.

Course intake limitations

The course intake would be limited by the number of instructors that may be available to conduct the course effectively. The maximum trainee–instructor ratio may be up to 24 to 1 for classroom lectures, and 8 to 1 for practical sessions and simulations. Teaching staff should note that the ratios are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability and equipment available.

Staff requirements

Instructors, supervisors and assessors are to be appropriately qualified in accordance with the STCW Convention or other applicable IMO instruments for the particular types and levels of training or assessment of competence of the trainees. It is left to the Administration to decide staff requirements in accordance with their national regulations.

Teaching facilities and equipment

For the theoretical part of the course, lectures and exercises should be held in spaces suitable for the class intake, and equipped with the relevant facilities including relevant multi-media equipment, to facilitate the delivery of the training through lectures, group exercises and discussions, as appropriate.

In order to conduct effective practical training, it would be advantageous to the trainees if training providers could ensure the availability of relevant actual and simulation equipment, as deemed necessary, that would facilitate the achievement of the learning objectives for the KUPs in table A-III/7 of the STCW Code.

Suitable learning spaces and workshops for lectures, discussions, individual and group training should be used, and provided with appropriate and relevant training aids including multimedia equipment and a simulator, if available.

Teaching aids (A)

A1 Visual presentations

A2 Equipment manufacturers' operations, service manuals and technical diagrams for relevant shipboard machinery and equipment

A3 Training equipment or simulator

Note: Multimedia training aids such as videos, computer-based training (CBT), etc. may be used as deemed fit by instructors when presenting this course.

IMO references (R)

R1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended

R2 International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended

R3 International Electro-Technical Commission (IEC) – 60092 Series: Electrical Installations in Ships

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Part B: General outline

Lectures

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. They should be well illustrated with diagrams, pictures and videos where appropriate, and must be related to those skills that will be necessary for the performance of duties on board ships.

An effective manner of presentation would be to develop techniques to transfer information and then reinforce the information. For example, share with the trainees briefly what instructors are about to present to them; then cover the topic in detail; and, finally, summarize what instructors have shared with them. The use of audiovisual aids, hand-outs and notes will all contribute to the effectiveness of the learning process.

Timetable

This model course has been developed providing a recommended 432 hours for lectures, demonstrations, laboratories, or simulator exercises and assessment – out of which 50% is recommended for practical training. No formal timetable is included in this model course.

Instructors must develop their own timetable depending on:

- level of skills of trainees;
- number of persons to be trained;
- number of instructors; and
- simulator facilities and equipment available,

and normal practices at the training establishment.

Function 1: Electrical, electronic and control engineering at the support level

This function has been developed providing a recommended 296 hours for lectures, demonstrations, laboratories, or simulator exercises and assessment – out of which 55% is recommended for practical training. No formal timetable is included in this model course.

Function 2: Maintenance and repair at the support level

This function has been developed providing a recommended 72 hours for lectures, demonstrations, laboratories, or simulator exercises and assessment – out of which 60% is recommended for practical training. No formal timetable is included in this model course.

Function 3: Controlling the operation of the ship and care for persons on board at the support level

This function has been developed providing a recommended 64 hours for lectures, demonstrations, laboratories, or simulator exercises and assessment – out of which 20% is recommended for practical training. No formal timetable is included in this model course.

Course outline

The table below lists the competences and the knowledge, understanding and proficiency (KUPs) for this course in the sequence they are listed in table A-III/7 of the STCW Code.

Function 1: Electrical, electronic and control engineering at the support level

Subject area
1 Function introduction
2 Safe use of electrical equipment
2.1 Safe use and operation of electrical equipment
2.1.1 Safety precautions
2.1.2 Isolation procedures
2.1.3 Emergency procedures
2.1.4 Voltage levels
2.2 Knowledge of the causes of electric shock and precautions to be observed to prevent shock
2.2.1 Causes of electric shock
2.2.2 Precautions to prevent electric shock
3 Contribute to monitoring the operation of electrical systems and machinery
3.1 Basic knowledge of the operation of mechanical engineering systems
3.1.1 Prime movers, including main propulsion plant
3.1.2 Engine-room auxiliary machinery
3.1.3 Steering systems
3.1.4 Cargo-handling systems
3.1.5 Deck machineries
3.1.6 Hotel systems
3.2 Basic knowledge of:
3.2.1 Electro-technology and electrical machines theory
3.2.2 Electrical power distribution boards and electrical equipment
3.2.3 Fundamentals of automation, automatic control systems and technology
3.2.4 Instrumentation, alarm and monitoring systems
3.2.5 Electrical drives
3.2.6 Electro-hydraulic and electro-pneumatic control systems
3.2.7 Coupling, load sharing and changes in electrical configuration
4 Use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations
4.1 Safety requirements for working on shipboard electrical systems
4.2 Application of safe working practices
4.3 Construction and operational characteristics of shipboard AC and DC systems and equipment
4.4 Use of measuring instruments, machine tools and hand and power tools

Function 2: Maintenance and repair at the support level

	Subject area
1	**Function introduction**
2	**Contribute to shipboard maintenance and repair**
2.1	Ability to use lubrication and cleaning materials and equipment
2.2	Knowledge of safe disposal of waste materials
2.3	Ability to understand and execute routine maintenance and repair procedures
2.4	Understanding manufacturer's safety guidelines and shipboard instructions
3	**Contribute to the maintenance and repair of electrical systems and machinery on board**
	Safety and emergency procedures
3.1	Basic knowledge of electro-technical drawings and safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
3.2	Test, detect faults and maintain and restore electrical control equipment and machinery to operating conditions
3.3	Electrical and electronic equipment operating in flammable areas
3.4	Basics of ship's fire-detection system
3.5	Carrying out safe maintenance and repair procedures
3.6	Detection of machinery malfunction, location of faults and action to prevent damage
3.7	Maintenance and repair of lighting fixtures and supply systems

Function 3: Controlling the operation of the ship and care for persons on board at the support level

	Subject area
1	**Function introduction**
2	**Contribute to the handling of stores**
2.1	Knowledge of procedures for safe handling, stowage and securing of stores
3	**Apply precautions and contribute to the prevention of pollution of the marine environment**
3.1	Knowledge of the precautions to be taken to prevent pollution of the marine environment
3.2	Knowledge of use and operation of anti-pollution equipment/agent
3.3	Knowledge of approved methods for disposal of marine pollutants
4	**Apply occupational health and safety procedures**
4.1	Knowledge of safe working practices and personal shipboard safety, including:
4.1.1	Electrical safety
4.1.2	Lock-out/tag-out
4.1.3	Mechanical safety
4.1.4	Permit to work systems
4.1.5	Working aloft
4.1.6	Working in enclosed spaces
4.1.7	Lifting techniques and methods of preventing back injury
4.1.8	Chemical and bio-hazard safety
4.1.9	Personal safety equipment

Part C: Detailed outline

The detailed outline has been written in learning outcomes format in which the outcome describes what the trainee must do to demonstrate that the specified knowledge or skill has been acquired and the proper attitude has been developed. All the outcomes are understood to be prefixed by the words, "At the end of the session, the trainees should be able to ....."

Function 1: *Electrical, electronic and control engineering at the support level*

Learning outcome	IMO reference	Other references	Teaching aid
1 **Function introduction**	R1	B2	A1
2 **Safe use of electrical equipment**	R1, R2, R3,	B2, B4, B5, B6, B7, B8, B10, B12 B14, B18, B19	A1, A2, A3
2.1 Safe use and operation of electrical equipment			
2.1.1 Safety precautions			
.1 explain safety instructions before commencing work or repair with electrical equipment and machinery			
.2 describe safety procedures prior to commencing work on shipboard electrical systems, machinery and equipment in a given laboratory exercise			
2.1.2 Isolation procedures			
.1 explain isolation procedures of various electrical systems, machinery and equipment			
.2 explain the purpose of proper communications in the execution of isolation task			
.3 describe the earthing systems for an electrical system on board			
.4 under supervision isolate electrical systems, machinery and equipment from a power source in accordance with appropriate procedures			
2.1.3 Emergency procedures			
.1 explain the emergency procedures applicable to a given emergency situation			
.2 recognize potential electrical hazards and unsafe equipment in a given scenario			
.3 apply the emergency procedures in a given scenario involving electrical shock			
.4 report an electrical hazard and unsafe equipment in accordance with prescribed procedure			
2.1.4 Voltage levels			
.1 describe the procedures and precautionary measures associated with various voltage levels and sources on board ship			
.2 explain safe voltages for hand-held equipment	R1, R2, R3	B2, B5, B6, B8	A1, A2
.3 explain the risks associated with high voltages			

Learning outcome	IMO reference	Other references	Teaching aid
2.2 Knowledge of the causes of electric shock and precautions to be observed to prevent shock 2.2.1 Causes of electric shock .1 explain various sources and causes of electric shock on board .2 identify hazards associated with electric shock .3 recognize potential electrical hazards and unsafe equipment in a given scenario 2.2.2 Precautions to prevent electric shock .1 identify precautionary measures to prevent electric shock .2 explain first aid procedures in the event of an electric shock			
3 Contribute to monitoring the operation of electrical systems and machinery 3.1 Basic knowledge of the operation of mechanical engineering systems 3.1.1 Prime movers and propulsion plant .1 list the operational parameters of electrical systems and equipment associated with the propulsion plant in accordance with operating manuals .2 describe the performance levels of all parameters to be monitored on the propulsion plant in accordance with technical specifications .3 explain the operating principles of prime movers and propulsion plant in accordance with operating manuals 3.1.2 Engine-room auxiliary machineries .1 identify the operational parameters of engine-room auxiliary machineries and equipment associated with a propulsion plant that must be monitored in accordance with operating manuals .2 describe the performance levels of all parameters to be monitored on the engine-room auxiliary machineries and equipment in accordance with technical specifications .3 explain the operating principles of engine-room auxiliary machineries in accordance with operating manuals	R1, R2, R3	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B16, B17, B18, B19	A1, A2, A3

Learning outcome	IMO reference	Other references	Teaching aid
3.1.3 Steering systems .1 identify the operational parameters of vessel steering machinery and equipment and machinery that must be monitored in accordance with operating manuals .2 describe the performance levels of all parameters monitored on a vessel steering machinery and equipment, in accordance with the manufacturer's operating manual, of the following steering types: – ram type; – rotary vane; – azipod drive; and – directional water-jet .3 explain the operating principles of steering systems in accordance with operating manuals 3.1.4 Cargo-handling systems .1 list the operational parameters of vessel cargo handling machinery and equipment that must be monitored in accordance with operating manuals .2 describe the performance levels of all parameters monitored on a vessel cargo handling machinery and equipment, in accordance with the manufacturer's operating manual, of the following equipment: – winches or derricks; – cranes; – variable and constant speed motors; and – variable and constant pumps .3 explain the operating principles of cargo-handling systems in accordance with operating manuals 3.1.5 Deck machineries .1 list the operational parameters of vessel deck machinery and equipment that must be monitored in accordance with operating manuals .2 describe the performance levels of all parameters monitored on a vessel deck machinery and equipment, in accordance with the manufacturer's operating manual, including the following equipment: – tension winches; – windlass; – capstans; – hatch covers; – ramp controls; and – segregation doors .3 explain the operating principles of deck machineries in accordance with operating manuals			

Learning outcome	IMO reference	Other references	Teaching aid
3.1.6 Hotel systems			
.1 list the operational parameters of vessel hotel machinery and equipment that must be monitored in accordance with operating manuals			
.2 describe the performance levels of all parameters monitored on a vessel hotel machinery and equipment, in accordance with the manufacturer's operating manual, including the following equipment: – vent dampers; – accommodation heating; – air conditioning and ventilation; – sanitary systems and equipment; – potable systems and equipment; – sewage systems and equipment; – galley equipment and laundry equipment; – communication devices; and – entertainment systems			
.3 explain the operating principles of hotel systems in accordance with operating manuals			
3.2 Basic knowledge of:			
3.2.1 Electro-technology and electrical machines theory			
.1 explain electro-technology and electrical machines theories			
.2 list specific on-board applications of electro-technology and electrical machines theories			
.3 explain the principle of operation of various types of electrical machines installed on board			
3.2.2 Electrical power distribution boards and electrical equipment			
.1 explain arrangement of shipboard electrical power distribution system			
.2 identify electrical equipment comprising the electrical power distribution system			
.3 identify devices, instruments and electrical equipment installed in electrical power distribution boards			
.4 determine parameters to be monitored in the electrical distribution boards in accordance with operating manual			

Learning outcome	IMO reference	Other references	Teaching aid
3.2.3 Fundamentals of automation, automatic control systems and technology			
.1 list on-board operations controlled by automatic control systems and technology			
.2 explain principles of operation of automatic control systems			
.3 identify the component parts that constitute an automatic control system and explain their function			
.4 describe parameters to be monitored in automatic control systems in accordance with operating manual			
3.2.4 Instrumentation, alarm and monitoring systems			
.1 explain how parameters to be monitored are measured using various devices or instruments installed in machineries and equipment, including in alarm systems			
.2 identify devices and instruments used in measuring various parameters			
.3 explain the principles of operation of various measuring devices and instruments			
3.2.5 Electrical drives			
.1 list shipboard operations employing electrical drives			
.2 identify component parts of electrical drives			
.3 explain the function of each component part of an electrical drive			
.4 explain the principle of operation of electrical drives			
.5 describe parameters to be monitored in electrical drives in accordance with operating manual			
3.2.6 Electro-hydraulic and electro-pneumatic control systems			
.1 list shipboard operations employing electro-hydraulic and electro-pneumatic control systems			
.2 identify component parts of electrical, electro-hydraulic and electro-pneumatic control systems			
.3 explain the function of each component part of an electro-hydraulic and electro-pneumatic control system			
.4 explain the principle of operation of electro-hydraulic and electro-pneumatic control systems			
.5 describe parameters to be monitored in electro-hydraulic and electro-pneumatic control systems in accordance with operating manual			
3.2.7 Coupling, load sharing and changes in electrical configuration			
.1 explain circumstances on board ship which may lead to changes in electrical configuration			
.2 explain the procedure for load sharing			
.3 describe parameters to be monitored in load sharing operations in accordance with operating manual			

Learning outcome	IMO reference	Other references	Teaching aid
4 Use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations	R1, R2, R3	B2, B3,B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18 B19	A1, A2, A3
4.1 Safety requirements for working on shipboard electrical systems			
.1 explain safety requirements for working on shipboard electrical systems			
.2 apply safety requirements involving shipboard electrical systems in accordance with the Safety Management System (SMS) manual in a given laboratory activity			
4.2 Application of safe working practices (basic knowledge):			
.1 explain the principles and procedures for safe working practices			
.2 demonstrate the principles and procedures for safe working practices when performing tasks in a given laboratory activity			
4.3 Construction and operational characteristics of shipboard AC and DC systems and equipment			
.1 explain the principles of operation of alternating current (AC) and direct current (DC) circuits			
.2 describe the construction and operational characteristics of shipboard AC and DC systems and equipment			
4.4 Use of measuring instruments, machine tools and hand and power tools			
.1 select appropriate hand tools, measuring instruments and testing equipment and inspect and repair electrical equipment and machinery in the most efficient and safe manner in a given task			
.2 use hand tools correctly and inspect, maintain and repair electrical equipment and machinery in the safest and most efficient manner in accordance with the manufacturer's guidelines			
.3 use measuring instruments and testing equipment correctly and record results accurately and electrical equipment functions properly after maintenance and repair tasks are completed			

Function 2: Maintenance and repair at the support level

Learning outcome	IMO reference	Other references	Teaching aid
1 Function introduction	R1	B2	A1
2 Contribute to shipboard maintenance and repair 2.1 Ability to use lubrication and cleaning materials and equipment .1 use lubrication and cleaning materials for maintenance and repair works in accordance with the manufacturer's safety and technical specifications and accepted industry practices in a given exercise 2.2 Safe disposal of waste materials .1 state that the disposal of waste materials is to be carried out in a safe manner in accordance with the manufacturer's safety and technical specifications, national and international laws, and accepted industry practices .2 describe the procedure for safe disposal of waste materials 2.3 Routine maintenance and repair procedures .1 explain maintenance and repair procedures in accordance with manufacturer's manual and technical specifications .2 conduct maintenance and repair in accordance with prescribed procedures in a given simulated scenario 2.4 Understanding manufacturer's safety guidelines and shipboard instructions .1 describe the manufacturer's safety guidelines and shipboard instructions	R1, R2, R3	B2, B3, B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18, B19	A1, A2, A3
3 Contribute to the maintenance and repair of electrical systems and machinery on board *Safety and emergency procedures* 3.1 Basic knowledge of electro-technical drawings and safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment .1 interpret ship's technical drawings and schematics .2 under supervision isolate plant machinery and equipment in accordance with shipboard safety procedures and technical specifications .3 select and use appropriate measuring, calibrating and test instruments 3.2 Test, detect faults and maintain and restore electrical control equipment and machinery to operating conditions .1 test the performance and detect potential faults of electrical control equipment and machinery after a maintenance procedure has been completed	R1, R2, R3	B2, B3, B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18, B19	A1, A2

Learning outcome	IMO reference	Other references	Teaching aid
3.3 Electrical and electronic equipment operating in flammable areas			
.1 list electrical and electronic equipment on board ship operating in flammable areas			
.2 explain precautionary measures to be observed when working with electrical and electronic equipment operating in flammable areas			
.3 apply precautionary measures when working with electrical and electronic equipment in a given scenario			
3.4 Basics of ship's fire-detection system			
.1 identify types and location of ship's fire-detection system on board ship			
.2 explain the operation of ship's fire-detection system			
.3 explain maintenance procedure of ship's fire-detection system			
3.5 Carrying out safe maintenance and repair procedures			
.1 disassemble plant machinery and equipment in accordance with shipboard maintenance requirements and technical manuals in a laboratory			
.2 assemble plant machinery and equipment in accordance with shipboard maintenance requirements and technical manuals in a laboratory			
3.6 Detection of machinery malfunction, location of faults and action to prevent damage			
.1 compare system and machinery performance data to manufacturer's technical specifications to identify system and machinery malfunctions			
.2 describe appropriate actions to prevent damage to machineries			
3.7 Maintenance and repair of lighting fixtures and supply systems			
.1 explain maintenance and repair procedures of shipboard lighting fixtures and supply systems			
.2 perform maintenance and repair to shipboard lighting fixtures and supply systems in a laboratory			

Function 3: Controlling the operation of the ship and care for persons on board at the support level

Learning outcome	IMO reference	Other references	Teaching aid
1 Function introduction	R1	B2	A1
2 Contribute to the handling of stores	R1, R2, R3	B2, B3, B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18, B19	A1, A2, A3
2.1 Knowledge of procedures for safe handling, stowage and securing of stores			
.1 Ability to handle, stow and secure stores safely			
– demonstrate the operation of the hoists/cranes used for handling the ship's stores/spares			
– state that each handling gear has its capabilities and limitations			
– understand that all handling gear and equipment shall be visually inspected			
– state that all ropes and wires should come with the certificate of their properties			
– demonstrate basic visual checks of hoists, cranes and related equipment			
– understand the importance that any failure, damage or malfunction has to be reported to EOOW immediately			
– state that no person should stand, pass or work under a suspended load			
– describe the provision of adequate lighting for working spaces, portable lights and precaution with dangerous stores			
– describe the importance of maintaining close communication with the personnel on charge ashore during the handling of stores			
– demonstrate the basic signals for the operation of hoists and cranes			
– demonstrate commonly used hand signals for control of lifting appliances, e.g. Code of Hand Signals			
– understand that in case of dead spots during stores operation, additional signallers have to be available			
– identify and explain SWL or WWL of equipment			
– understand that a load greater than SWL shall not be lifted			
– identify SWL of shackles, chains and slings correctly			
– demonstrate a working knowledge of different lashing techniques			
– stow, lash and secure the stores/spares safely under supervision of duty officer			
– understand the classification of dangerous stores			
– understand the reason and need for segregation of dangerous stores			
– describe procedures to follow in event of spillage of dangerous stores			

Learning outcome	IMO reference	Other references	Teaching aid
.2 Hoists and cranes – demonstrate a working knowledge of the different types and function principles of cranes, derricks and winches – demonstrate the performance of basic visual checks of cranes, derricks, winches and related equipment – understand the importance that any failure, damage or malfunction has to be reported to EOOW immediately – prepare and use cranes, derricks and winches – understand and use basic signals for the operation of hoists and cranes when used for engine maintenance – understand that in case of dead spots during cargo or stores operation, additional signallers have to be available – correctly identify SWL of shackles, chains and slings – demonstrate a working knowledge of the use of slings to lift and move different kinds of cargo/ equipment in a secure and safe manner .3 Access arrangements, hatches and hatch covers, ramps, side/bow/stern doors or freight elevators – understand the safety hazards during opening/ closing of ramps, doors, freight elevators, etc. – demonstrate a working knowledge of operating ramps, doors, freight elevators, etc. – understand the need to report immediately any defects in lifting equipment and gear – understand the effect of unsecured doors on the stability and watertight integrity of the ship			

Learning outcome	IMO reference	Other references	Teaching aid
3 Prevention of pollution of the marine environment	R1, R2, R3	B2, B3, B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18, B19	A1, A2
3.1 Knowledge of the precautions to prevent pollution of the marine environment			
.1 Basic knowledge of MARPOL 73/78			
– state the need to protect the marine environment			
– state that marine pollutants must be safely disposed of ashore in compliance with MARPOL			
– state that there are strict mandatory rules covering all ships for the disposal of oily water mixture			
– state that there are strict mandatory rules covering all ships for the disposal of noxious liquid substances			
– state that there are strict mandatory rules covering all ships for the disposal of harmful substances in packaged form			
– state that there are strict mandatory rules covering all ships for the prevention of pollution by sewage			
– state that there are strict mandatory rules covering all ships for the prevention of pollution by garbage			
– state that there are strict mandatory rules covering all ships for the prevention of air pollution by ships			
.2 Proactive measures to protect the marine environment			
– describe the use of deck scuppers for bunkering purposes			
– describe the assistance required during bunkering operations			
– describe the use of an emergency stop during bunkering			
– demonstrate an understanding to recognize the need to seek advice if unsure of measures to be taken to protect the marine environment			
3.2 Knowledge of use and operation of anti-pollution equipment/agent			
.1 Operating procedures of anti-pollution equipment			
– describe emergency response exercises for controlling spillage of oil on board			
– demonstrate the duties assigned to the crew as per SOPEP			
– describe drills for clean-up of hazardous cargo spillage			
– demonstrate knowledge of operating garbage compactor units (where fitted)			

Learning outcome	IMO reference	Other references	Teaching aid
3.3 Approved methods for disposal of marine pollutants .1 Disposal of garbage – demonstrate knowledge of collecting and segregating waste and garbage – demonstrate knowledge of collecting and disposing of cargo sweepings – state the need to segregate waste, record the amounts of waste and landing waste ashore for disposal .2 Exchange of ballast water – state the purpose of ballast water exchange .3 Disposal of bilge water – state the correct method of disposing bilge water, waste oil and oily garbage			
4 Apply occupational health and safety procedures 4.1 Working knowledge of safe working practices and personal shipboard safety, including: 4.1.1 Electrical safety .1 demonstrate a working knowledge of electrical safety .2 describe the harmful effects of direct and alternating current on human's heart and body functions .3 demonstrate the Five Safety Rules .4 describe the function and principles of electric power operated tools and equipment .5 demonstrate safe working practices when using electric power operated tools and equipment .6 describe the function and principles of portable electric tools, portable lighting and portable electric equipment together with associated risks .7 state that for certain tasks portable lighting with safety extra-low voltage has to be used .8 demonstrate the basic visual and function checks on electric power operated tools, electric lighting and electric equipment .9 state that any failure, damage or malfunction of electric power operated tools, electric lighting and electric equipment has to be reported to EOOW immediately 4.1.2 Lock-out/tag-out .1 explain the principles of lock-out/tag-out safety procedures .2 apply lock-out/tag-out procedures in accordance with good engineering principles in a given exercise	R1, R2, R3	B2, B3, B4, B5, B6, B7, B8, B9, B10, B12, B13, B14, B17, B18, B19	A1, A2, A3

Learning outcome	IMO reference	Other references	Teaching aid
4.1.3 Mechanical safety			
.1 describe the function and principles of mechanical tools and mechanical equipment			
.2 demonstrate safe working practices when using mechanical tools and mechanical equipment			
.3 describe the risks associated with hydraulic and pneumatically operated mechanical tools and mechanical equipment			
4.1.4 Permit to work systems			
.1 describe the need for permit to work systems used on board			
.2 define in general the meaning of risk assessment			
.3 state the safety procedures that have to be strictly followed on board when applying a permit to work system			
.4 describe the construction, classification, visual and function checking and use of additional protective equipment			
.5 demonstrate the understanding that any failure, damage or malfunction of safety and protective equipment has to be reported to officer in charge immediately			
4.1.5 Working aloft			
.1 demonstrate safe working practices while working aloft including the use of ladders			
.2 demonstrate safe working practices while working over the side			
.3 demonstrate the use of all necessary safety equipment			
4.1.6 Working in enclosed spaces			
.1 define and understand the term enclosed space			
.2 identify typical enclosed spaces and potentially dangerous spaces on board			
.3 state clearly the safety procedures to be followed with regard to entry into enclosed spaces and responsibilities that are defined			
.4 demonstrate safe working practices with regard to entry into enclosed spaces			
.5 demonstrate the ability to use breathing apparatus when working in enclosed spaces			
4.1.7 Lifting techniques and methods of preventing back injury			
.1 demonstrate safe working practices and personal shipboard safety when applying lifting techniques and methods for preventing back injury			
.2 demonstrate safe working practices during manual lifting and carrying loads			
.3 demonstrate correct manual handling techniques			

Learning outcome	IMO reference	Other references	Teaching aid
4.1.8 Chemical and bio-hazard safety .1 state if product details and potential hazards are found in suppliers' safety data sheet .2 describe how to comply with health, hygiene and safety requirements when handling hazardous substances .3 demonstrate the need to follow instructions and precautions when working with cleaning fluids, paints, toxic materials, etc. .4 state that additional personal protective equipment has to be used .5 describe the need to seek advice if unsure of risks or hazards relating to materials 4.1.9 Personal safety equipment .1 describe construction, material, classification, marking, visual and function checking and use of personal protective equipment .2 state the need to use personal protective equipment .3 state that any failure, damage or malfunction of personal protective equipment has to be reported to officer in charge immediately .4 describe the meaning of prohibition, warning, mandatory and emergency safety and signage			

Part D: Instructor manual

Introduction

Based on knowledge, understanding and proficiency (KUPs) in part C, the Instructor manual is intended to provide guidance and more detailed information to instructors who use IMO model courses that is relevant to the organization and structuring of the learning objectives, sequence of lectures, possible problems and solutions during the course. The course is structured to reflect the KUPs as specified in table A-III/7 of the STCW Code.

The Instructor manual and its Guidance notes provide highlights and a summary of the topics that are to be presented. The manual provides information on teaching methodology and organization, and the areas that are considered appropriate and important to achieve the relevant learning outcomes. Instructors should prepare relevant lesson plans for the delivery of each topic of the course specifying the teaching strategy and method to be used, and describe the learning activities of the trainees.

The Guidance notes are presented in accordance with the Course outline wherein the subject area is divided into three (3) functions, as follows:

Function 1: Electrical, electronic and control engineering at the support level

1 Function introduction;

2 Safe use of electrical equipment;

3 Contribute to monitoring the operation of electrical systems and machinery; and

4 Use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations.

Function 2: Maintenance and repair at the support level

1 Function introduction;

2 Contribute to shipboard maintenance and repair; and

3 Contribute to the maintenance and repair of electrical systems and machinery on board.

Function 3: Controlling the operation of the ship and care for persons on board at the support level

1 Function introduction;

2 Contribute to the handling of stores;

3 Apply precautions and contribute to the prevention of pollution of the marine environment; and

4 Apply occupational health and safety procedures.

Guidance notes for lectures and practical activities

Function 1: Electrical, electronic and control engineering at the support level

1 *Function introduction*

The introductory lesson by the instructor emphasizes the importance for trainees to be able to demonstrate the knowledge, understanding and proficiency for the competences for the effective and safe performance of duties and functions as electro-technical rating.

Instructors should explain to the trainees the expected learning outcomes, by using examples of tasks undertaken on board ships, to facilitate a general understanding of the function objectives.

The following competences for the function Electrical, electronic and control engineering at the support level in table A-III/7 of the STCW Code should be explained and matched with specific tasks and operations on board:

- safe use of electrical equipment;
- contribute to monitoring the operation of electrical systems and machinery; and
- use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations.

2 *Safe use of electrical equipment*

2.1 Safe use and operation of electrical equipment

2.1.1 Safety precautions

Working safely with electrical equipment cannot be overemphasized such that the safety instructions before commencing work or repair with various electrical equipment and machineries on board ships shall be thoroughly explained.

The safety precautions and safety procedures, in SMS manuals, manufacturer's manual and/or company policies, prior to commencing work on shipboard electrical systems, machinery and equipment shall be presented and observed when performing assigned tasks in a laboratory exercise, including the use of work permits and appropriate personal protective equipment (PPE).

2.1.2 Isolation procedures

One of the ways of ensuring safety when working with electrical systems is having knowledge of isolation procedures of various electrical systems, machinery and equipment, which is the focus of the discussion and practical laboratory exercise in this topic.

The isolation procedure would be put into practice during the practical laboratory exercise with electrical systems, machinery and equipment. Another important skill to be practised during the practical laboratory exercise is to observe the proper communications in the execution of isolation tasks.

2.1.3 Emergency procedures

As various types of emergencies may possibly occur on board ships, this topic aims to explain the appropriate emergency procedures based on an approved SMS manual and suitable to a specific type of emergency situation, to ensure safety of the crew, cargo and the vessel.

In a practical exercise, trainees will be required to recognize electrical hazards and unsafe equipment. They will be able to learn about report preparation and applying emergency procedures.

2.1.4 Voltage levels

This topic focuses on the precautionary measures and procedures to be observed when working with various voltage levels and electrical power sources in various loads on board a ship. The safe voltage requirements for hand-held equipment should be explained and the consequent risks associated with high voltages (above 1,000 volts).

2.2 Knowledge of the causes of electric shock and precautions to be observed to prevent shock

2.2.1 Causes of electric shock

In this topic, instructors should emphasize to trainees that various sources of electrical shock on board vessels that expose crew to hazards and risks will be identified.

Instructors should provide information and guidance, in practical laboratory exercises, to trainees on how to recognize electrical hazards and unsafe equipment, and the procedure of report preparation will be practised.

2.2.2 Precautions to prevent electric shock

Instructors should provide trainees with information and guidance on the precautionary measures to be taken for the prevention of electric shock, including the use of appropriate tools and measuring equipment. The appropriate first aid procedure to be applied in providing immediate medical or first aid attention in the event of an electrical shock should also be included under this topic.

3 *Contribute to monitoring the operation of electrical systems and machinery*

3.1 Basic knowledge of the operation of mechanical engineering systems

3.1.1 Prime movers and propulsion plant

The learning objective of this topic is for trainees to learn how to identify the operational parameters of various electrical systems and equipment on board ships that are associated with the propulsion plant, based on the respective operating manuals.

In practical laboratory exercises, trainees will be able to observe and describe the desired performance levels of relevant parameters to be monitored on the propulsion plant, based on technical specifications, and the appropriate actions to be taken when parameters reach abnormal levels.

3.1.2 Engine-room auxiliary machineries

As electro-technical ratings work with engine-room auxiliary machineries, they are expected to initially identify the operational parameters to be monitored in accordance with operating manuals. In practical laboratory exercises, the desired performance levels of such parameters would be described based on technical specifications.

3.1.3 Steering systems

This topic focuses on identifying the operational parameters of a ship's steering gear and equipment that must be monitored during the actual performance of their duties as electro-technical rating. Upon identification, the normal performance levels should be described and noted when monitored during a laboratory exercise, and compared with manufacturer's operating instructions for the following steering types:

- ram type;
- rotary vane;
- azipod drive; and
- directional water-jet.

3.1.4 Cargo-handling systems

In this topic, trainees will be able to learn how to identify the operational parameters in accordance with operating manuals of a ship's cargo handling machinery and equipment including specialized cargo unit, for example, reefer container.

Trainees will be able to learn how to monitor the normal performance levels of all parameters within a ship's cargo handling machinery and equipment during practical laboratory exercises against the manufacturer's operating instructions for the following equipment:

- winches or derricks;
- cranes;
- variable and constant speed motors; and
- variable and constant pumps.

3.1.5 Deck machineries

This lesson will provide information for trainees to gain knowledge to identify the operational parameters of various deck machinery and equipment to be monitored in the performance of their tasks as electro-technical rating.

Further, trainees will be able to learn to monitor the performance levels of all parameters of a ship's deck machinery and equipment in practical laboratory exercises, and to compare such levels with the manufacturer's operating instructions for the following equipment:

- tension winches;
- windlass;
- capstans;
- hatch covers;
- ramp controls; and
- segregation doors.

3.1.6 Hotel systems

This topic provides information for trainees to gain knowledge to identify the operational parameters of a ship's hotel machinery and equipment that are required to be regularly monitored.

Through practical laboratory exercises, trainees will be able to describe the performance levels of all parameters and compare them with manufacturer's operating instructions, for the following equipment:

- vent dampers;
- accommodation heating;
- air conditioning and ventilation;
- sanitary systems and equipment;
- potable systems and equipment;
- sewage systems and equipment;
- galley equipment and laundry equipment;
- communication devices; and
- entertainment systems.

3.2 Basic knowledge of:

3.2.1 Electro-technology and electrical machines theory

In discussing the electrical engineering systems, trainees will be able to learn the theory of electro-technology and the principles of operation of electrical machines. Demonstrated in this topic is the procedure of operating various types of electrical machines installed on board.

3.2.2 Electrical power distribution boards and electrical equipment

Using illustrations, instructors should introduce trainees to shipboard electrical power distribution systems and arrangements. Trainees should gain knowledge to be able to identify the electrical equipment that comprises the electrical power distribution system. Trainees should be able to identify devices, instruments and electrical equipment installed in electrical power distribution boards, during practical laboratory exercises. Trainees should be able to describe each parameter to be monitored in the electrical power distribution boards in accordance with relevant operating instructions.

3.2.3 Fundamentals of automation, automatic control systems and technology

This topic will provide information to electro-technical ratings on the parameters to be monitored in automatic control systems and compared with operating manual, and introduce them to various on-board operations wherein automatic control systems and technology are applied. Trainees will be able to gain knowledge on the basic principles of operation of automatic control systems and to be able to identify the component parts that constitute an automatic control system and their function, in a practical laboratory exercise.

3.2.4 Instrumentation, alarm and monitoring systems

This topic provides information, through practical laboratory exercises, for trainees to gain knowledge in identifying parameters to be monitored and measured in various devices or instruments installed in machinery and equipment, including in alarm systems. Trainees would learn to use devices and instruments used in measuring various parameters. Finally, trainees will be able to learn the principles of operation of various measuring devices and instruments.

3.2.5 Electrical drives

Instructors should provide information to trainees to gain the knowledge to be able to cite shipboard operations employing electrical drives and identify the component parts. They will also learn the function of each component part and explain the principle of its operation. Trainees will be able to learn through practical laboratory exercises how to identify the normal parameters to be monitored in accordance with operating instructions.

3.2.6 Electro-hydraulic and electro-pneumatic control systems

In this topic, instructors should provide information, in practical laboratory exercises, for trainees to gain knowledge and understanding of on-board operations that employ electro-hydraulic and electro-pneumatic control systems. Trainees will be able to identify component parts of electrical, electro-hydraulic and electro-pneumatic control systems and explain their functions and principles of operation, and identify the parameters to be monitored.

3.2.7 Coupling, load sharing and changes in electrical configuration

Instructors should provide information to trainees about various circumstances on board ship which may lead to changes in electrical configuration. Through practical laboratory exercises, trainees will be able to gain knowledge of the procedures for load sharing and determine parameters to be monitored while performing load sharing operations in accordance with operating instructions.

4 *Use hand tools, electrical and electronic measurement equipment for fault finding, maintenance and repair operations*

4.1 Safety requirements for working on shipboard electrical systems

Instructors should provide information to trainees to gain knowledge of the safety requirements for working on shipboard electrical systems. Trainees will be able to apply the safety requirements in a given practical laboratory activity involving shipboard electrical systems in accordance with the SMS manual.

4.2 Knowledge of application of safe working practices

Instructors should introduce to trainees, through practical laboratory exercises, the principles and procedures for safe working practices to enable them to observe such principles being applied to shipboard operations.

4.3 Construction and operational characteristics of shipboard AC and DC systems and equipment

Instructors should provide information to trainees, through practical laboratory exercises, on the principles of operation of alternating current (AC) and direct current (DC) circuits to gain knowledge of the construction and operational characteristics of shipboard AC and DC systems and equipment.

4.4 Use of measuring instruments, machine tools and hand and power tools

In a practical laboratory exercise on this topic, trainees will be able to select and use appropriate hand tools, measuring instruments and testing equipment. They will be able to learn how to inspect and repair electrical equipment and machinery in the most efficient and safe manner.

Function 2: Maintenance and repair at the support level

1 *Function introduction*

The introductory lesson by the instructor emphasizes the importance for trainees to be able to demonstrate the knowledge, understanding and proficiency for the competences for the effective and safe performance of duties and functions as electro-technical rating.

Instructors should carefully explain to trainees, using examples, the tasks to be undertaken on board ships by electro-technical ratings.

The following competences for the function Maintenance and repair at the support level in table A-III/7 of the STCW Code should be explained and matched with specific tasks and operations on board, such as the following:

- contribute to shipboard maintenance and repair; and
- contribute to the maintenance and repair of electrical systems and machinery on board.

2 *Contribute to shipboard maintenance and repair*

2.1 Ability to use lubrication and cleaning materials and equipment

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge regarding the use of lubrication and cleaning materials for maintenance and repair works in accordance with the manufacturer's safety and technical specifications and accepted industry practices.

2.2 Knowledge of safe disposal of waste materials

Instructors should provide information, through practical laboratory exercises, for trainees to gain the knowledge and an appreciation of the procedures for disposal of waste materials on board in a safe manner in accordance with the manufacturer's safety and technical specifications, shipboard safety procedures, national and international laws, and accepted industry practices.

2.3 Ability to understand and execute routine maintenance and repair procedures

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge and understanding of how to apply maintenance and repair procedures of various on-board operations in a safe and acceptable manner.

2.4 Understanding manufacturer's safety guidelines and shipboard instructions

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge and understanding of manufacturer's and shipboard safety protocols and directions.

3 *Contribute to the maintenance and repair of electrical systems and machinery on board*

Safety and emergency procedures

3.1 Basic knowledge of electro-technical drawings and safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge to interpret a ship's technical drawings and schematics, and to analyse the out-of-range parameters or faults of electrical systems and machinery. Trainees should gain knowledge: to be able to isolate plant machinery and equipment guided by shipboard safety procedures and technical specifications; and in selecting and using appropriate measuring, calibrating and test instruments.

3.2 Test, detect faults and maintain and restore electrical control equipment and machinery to operating conditions

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge and skills in testing the performance, maintenance and repair of electrical control equipment and machinery.

3.3 Electrical and electronic equipment operating in flammable areas

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge to be able to identify the location of electrical and electronic equipment on board ship operating in flammable areas, and the precautionary measures to be observed when working with electrical and electronic equipment operating in flammable areas.

3.4 Basics of ship's fire-detection system

Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge to identify types and location of fire-detection systems on board ships and to apply relevant operation and maintenance procedures.

3.5 Carrying out safe maintenance and repair procedures

Instructors should provide information for trainees to gain knowledge and skills for assembling and disassembling plant machinery and equipment by following shipboard maintenance requirements.

3.6 Detection of machinery malfunction, location of faults and action to prevent damage

Instructors should provide information for trainees to gain knowledge of: the steps in comparing systems and machinery performance data with manufacturer's technical specifications; identifying system and machinery malfunctions; and identifying appropriate actions to prevent damage to machinery.

3.7 Maintenance and repair of lighting fixtures and supply systems

Lighting fixtures on board ship require special attention as they are exposed to adverse environmental conditions. Instructors should provide information, through practical laboratory exercises, for trainees to gain knowledge of the procedures to maintain and repair shipboard lighting fixtures and supply systems.

Function 3: Controlling the operation of the ship and care for persons on board at the support level

1 *Function introduction*

The introductory lesson by the instructor emphasizes the importance for trainees to be able to demonstrate the knowledge, understanding and proficiency for the competences for the effective and safe performance of duties and functions as electro-technical rating.

Instructors should carefully explain to trainees, using examples, the tasks to be undertaken on board ships by electro-technical ratings.

The following competences for the function Controlling the operation of the ship and care for persons on board at the support level in table A-III/7 of the STCW Code should be explained and matched with specific tasks and operations on board, such as the following:

- contribute to the handling of stores;
- apply precautions and contribute to the prevention of pollution of the marine environment; and
- apply occupational health and safety procedures.

In implementing this section of the course, instructors should ensure that trainees have prior and adequate training and experience as ratings forming part of an engineering watch, and have demonstrated the ability to perform tasks required of ratings.

In addition to the task description, the following aspects are important within the framework of the training:

- Relevant norms, legal provisions and safety working principles and regulations that have to be applied where they are not explicitly mentioned;
- Specifically focusing on the safety of the ship, work safety, health protection and first-aid measures; and
- Environmental protection, efficient use of energy and materials, effective communication and using nautical terminology during the ship's operation.

On completion of training for this function, trainees should be able to safely and efficiently contribute to handling of stores.

Trainees should have adequate knowledge and be able to identify occupational hazards and take appropriate measures and precautions prior to undertaking shipboard operations such as working aloft, working over the side and especially working in enclosed spaces. Trainees should have knowledge of the need for working permits and the application, where appropriate, of proper working techniques.

Trainees should be:

- aware of the need and the practical measures required by law to prevent pollution of the environment; and
- able to demonstrate the proper use and operation of anti-pollution equipment and have knowledge of the approved methods for disposal of marine pollutants.

2 *Contribute to the handling of stores*

In implementing this section of the course, instructors should ensure that trainees have prior and adequate training, competence and experience as ratings, and have demonstrated the ability to perform tasks required of ratings.

The ship's safety management system should provide guidance on safe practices in ship operations and ensuring a safe working environment, with safeguards against all identified risks in compliance with the ISM Code.

In addition, engine equipment and machinery should be:

- suitable for the work to be carried out;
- properly adapted for that purpose; and
- capable of being operated without any risks to the health or safety of any worker.

2.2.1 Knowledge of procedures for safe handling, stowage and securing of stores.

Instructors should refer to the references for further guidance on this topic.

2.2.1.1 Ability to handle, stow and secure stores safely

Stores are important for the operation of ships and need to be brought on board and stored properly, and could be handled with a variety of equipment. It is recommended that instructors inform trainees regarding the handling of stores and equipment.

Trainees should have knowledge of the working principles, operation, repair and maintenance of stores handling gear and associated equipment. With regard to the safe operation of this stores handling gear and associated equipment, trainees should gain an understanding of their use and their limitations.

It is very important that trainees achieve an understanding that only certified working gear and equipment may be used for stores handling.

Instructors should inform trainees about the risks involved and the common safety precautions and safe operation procedures when opening holds while handling stores.

2.2.1.2 Hoists and cranes

Instructors should explain and demonstrate to trainees the proper procedures for operating lifting gears and associated machinery when overhauling engines. The lifting gears and machinery should be operated in accordance with established safety practices as laid down in Code of Safe Working Practices (COSWP) and the relevant operating instructions.

Instructors should stress to trainees that there must be clear understanding between the lifting gear operator and the signalman regarding the type and meaning of the signals used. At the end of the training, trainees should be able to use and understand basic signals for the operation of equipment and machinery including cranes and hoists.

2.2.1.3 Access arrangements, hatches and hatch covers, ramps, side/bow/stern doors or freight elevators

Trainees should be made aware of the importance of maintaining watertight and weathertight integrity of the ship as many incidents of ship capsizing and sinking are due to flooding of ships' spaces resulting in loss of ship stability. All hatches, side/bow/stern doors and portholes, especially those below the main deck of the ship, have to be closed for watertight/weathertight integrity, as appropriate, before departure and throughout the voyage. Operation of these equipment and fittings should be in accordance with the manufacturer's manuals.

3 *Apply precautions and contribute to the prevention of pollution of the marine environment*

This section is intended to provide general knowledge of the MARPOL Convention. In the following sections, detailed treatment should be confined to general guidelines and precautions to be taken in the prevention of pollution of the marine environment, including the equipment and methods used for the disposal of marine pollutants relevant for the engine department.

Instructors should refer to Model course 1.38 on Marine environmental awareness for further information when presenting this section.

3.3.1 Knowledge of the precautions to be taken to prevent pollution of the marine environment

3.3.1.1 Basic knowledge of MARPOL 73/78

Due to the international nature of the shipping industry, IMO has laid down rules and requirements for the prevention of pollution of the marine environment, which are set out in MARPOL. Because of the fine balance that exists between the environment and ourselves, careless and deliberate pollution of the atmosphere and sea will ultimately destroy animals, plants, sea life and humans. It is therefore important that all efforts should be made to protect the environment.

The annexes of MARPOL set out the rules for the construction and equipment of ships and for ships' operations which may result in marine pollution.

Annexes of the MARPOL Convention are:

- Annex (1): Prevention of pollution by oil;
- Annex (2): Control of pollution by noxious liquid substances in bulk;
- Annex (3): Prevention of pollution by harmful substances carried by sea in packaged form;
- Annex (4): Prevention of pollution by sewage from ships;
- Annex (5): Prevention of pollution by garbage from ship; and
- Annex (6): Prevention of air pollution from ships.

3.3.1.2 Proactive measures to protect the marine environment

The goal is to develop the mindset to achieve a sense of personal responsibility through:

- knowledge and comprehension of the importance and diversity of the marine environment;
- recognition of the impact of human activities on the environment; and
- willingness to use solutions that lessen the impact of human actions.

Instructors should request the trainees to list or identify the pollutants that are commonly found on board ships and within the shipping environment.

Preventative measures to protect the marine environment may include:

- Prevention of the spillage of cargo;
- Prevention of the spillage of fuel and oil;
- Controlling the emissions of polluting gas and smoke;
- Policies and practices to minimize the spread and carriage of marine pests;

- Effective waste management and recycling processes;
- Effective management of ballast operations;
- Effective shipboard housekeeping;
- Measures to prevent run-off during slipping operations; and
- Clear and effective pollution control instructions.

3.3.2 Knowledge of use and operation of anti-pollution equipment/agent

3.3.2.1 Operating procedures of anti-pollution equipment

Instructors should provide an overview of the anti-pollution equipment used on board ships and highlight the equipment used in the engine department.

3.3.3 Knowledge of the approved methods for disposal of marine pollutants

Instructors should make trainees aware of the need for maintaining proper and accurate records of the respective activities related to incinerating, treating, dumping and disposal ashore, and creating an awareness of the types of waste that may be dumped at sea.

3.3.3.1 Disposal of garbage

Instructors should provide guidance to trainees on the relevant parts of Annex V of MARPOL 73/78 that are related to the safe disposal of garbage.

3.3.3.2 Exchange of ballast water

Instructors should teach trainees, taking into account the relevant parts of the Ballast Water Management Convention 2004.

3.3.3.3 Disposal of bilge water

Instructors should provide guidance to trainees on the relevant parts of MARPOL 73/78, Annex I that are related to the proper disposal of bilge water.

4 *Apply occupational health and safety procedures*

With respect to health and safety of crew members working on board ships, employers, ship owners, company and ship managers must ensure the following:

- Avoidance of risks by the replacement of dangerous practices, substances or equipment with safe practices, and using less dangerous substances and equipment; and
- Adaptation of work patterns and procedures taking into account the capacity of crew members, the equipment available and the prevailing circumstances during which the task is undertaken.

4.4.1 Safe working practices and personal shipboard safety

Instructors should stress that trainees are required to take reasonable care for their own health and safety, and that of others on board who may be affected by their acts or omissions. Trainees must carry out health and safety duties to the best of their capabilities. Proper use and operation of plant machinery must be strictly observed and adhered to, and hazards and deficiencies identified must be reported immediately.

In all instances, risks to the health and safety of workers must be identified and assessed. It will often not be possible to remove all risks, but attention shall be given to control measures which make the working environment and working methods as safe as reasonably practicable.

COSWP T15 describes safe working practices and personal shipboard safety including:

4.4.1.5 Working aloft

4.4.1.6 Working in enclosed spaces

4.2.1.4 Permit to work system

Instructors should provide information and guidance to trainees on the need for, and usage of, safe working permits, such as:

- hot work permit;
- cold work permit;
- entry in enclosed space permit;
- working aloft permit;
- working overside permit; and
- electrical isolation permit.

Part E: Evaluation and assessment

The effectiveness of any evaluation depends to a great extent on the precision of the description of what is to be evaluated. The detailed teaching syllabus is designed to assist trainees to meet the learning objectives, using descriptive verbs, for example those widely used in Bloom's Taxonomy.

Evaluation/Assessment is a way of finding out if learning has taken place. It enables the assessor (instructor) to ascertain if the trainee has gained the required skills and knowledge needed at a given point towards a course or qualification.

The purpose of evaluation/assessment is to:

- assist trainees' learning;
- identify trainees' strengths and weaknesses;
- assess the effectiveness of a particular instructional strategy;
- assess and improve the effectiveness of curriculum programmes; and
- assess and improve teaching effectiveness.

The different types of evaluation/assessment may be classified as follows:

Initial/Diagnostic assessment

Diagnostic assessment is an evaluation of a trainee's skills, knowledge, strength and areas for development. This should take place before the trainee commences a course to ensure they are on the right path. This can be carried out in an individual or group setting by the use of relevant tests.

Formative assessment

Is an integral part of the teaching/learning process and hence is a "continuous" assessment process. It provides information on a trainee's progress and may also be used to encourage and motivate them.

Purpose of formative assessment is to:

- provide feedback to trainees;
- motivate trainees;
- diagnose trainees' strengths and weaknesses; and
- help trainees to develop self-awareness.

Summative assessment

It is designed to measure trainees' achievement against defined objectives and targets. It may take the form of an examination or an assignment and takes place at the end of a course.

Purpose of summative assessment:

- To assess if trainees are competent or not yet competent; and
- To grade trainees.

Evaluation for quality assurance

Evaluation of the assessment process would be required for quality assurance purposes for compliance with the requirements of STCW Convention, regulation I/8.

Purpose of assessment with respect to quality assurance:

- To provide feedback to instructors on a trainee's learning;
- To evaluate a module's strengths and weaknesses; and
- To improve teaching and course outcomes.

Assessment planning

Assessment planning should be specific, measurable, achievable, realistic and time-bound (SMART).

Some methods of assessment that could be used depending upon the course/qualification are as follows and should be adapted to suit individual needs:

- Observation (in oral examination, simulation exercises, practical demonstration);
- Questions (written or oral);
- Tests;
- Assignments, activities, projects, tasks and/or case studies; and
- Simulations (also refer to STCW Code, section A-I/12).

Validity

The evaluation methods must be based on clearly defined objectives, and must truly represent what is meant to be assessed, for example only the relevant criteria and the syllabus or course guide. There must be a reasonable balance between the subject topics involved and also in the testing of trainees' knowledge, understanding and proficiency of the concepts.

Reliability

Assessments should be reliable (if the assessment was done again with a similar group/learner, would you receive similar results?). Instructors may have to deliver the same subject to different groups of learners at different times. If other assessors are also assessing the same course/qualification, it is to be ensured that all assessors make similar decisions.

To be reliable, an evaluation procedure should produce reasonably consistent results no matter which set of question papers or version of the test is used.

If instructors are to assess their own trainees, they need to clearly understand what they are to assess and then decide how to do this, bearing in mind that, for the award of Certificates of Competency (CoC) or Certificates of Proficiency (CoP) instructors may not assess their trainees to be in compliance with the requirements of the Convention.

The "what" will come from the standards/learning outcomes of the course/qualification they will deliver. The "how" may already be decided for them if it is an assignment, test or examination.

The instructors need to consider the best way to assess the skills, knowledge and attitudes of learners, whether this will be formative and/or summative, and how the assessment will be valid and reliable.

All work assessed should be valid, authentic, current, sufficient and reliable; this is often known as VACSR – "valid assessments create standard results":

- **V**alid – the work is relevant to the standards/criteria being assessed;
- **A**uthentic – the work has been produced solely by the learner;
- **C**urrent – the work is still relevant at the time of assessment;
- **S**ufficient – the work covers all the standards/criteria; and
- **R**eliable – the work is consistent across all learners, over time and at the required level.

It is important to note that no single method can satisfactorily measure knowledge and skill over the entire spectrum of subjects to be tested for the assessment of competence.

Care should therefore be taken to select the method most appropriate to the particular aspect of competence to be tested, bearing in mind the need to frame questions which relate as realistically as possible to the requirements of the tasks on board.

STCW Convention 1978, as amended

The training and assessment of seafarers, as required by the Convention, are administered, supervised and monitored in accordance with the provisions of section A-I/6 of the STCW Code.

The knowledge, understanding and proficiency in column 2, methods for demonstrating competence in column 3 and criteria for evaluating competence in column 4 of table A-III/7 of the STCW Code set out the methods and criteria for evaluation. Instructors should refer to the competence table when designing assessments.

Evaluation of competence

The arrangements for evaluating competence should be designed to take account of different methods of assessment which can provide different types of evidence about candidates' competence, for example:

- direct observation of work activities;
- skills/proficiency/competency tests;
- projects and assignments;
- evidence from previous experience; and
- written, oral and computer-based questioning techniques.

One or more of the above methods listed could be used to obtain evidence of ability, in addition to appropriate questioning techniques to provide evidence of supporting knowledge and understanding.

For detailed guidance on Assessments, instructors should refer to Model course 3.12 on Assessment, examination and certification of seafarers.

Multiple choice questions

Marking or scoring would be easier when multiple-choice test items are used, but in some cases difficulties may arise in creating plausible distracters.

Detailed sampling allows immediate identification of errors of principle and those of a clerical nature. It must be emphasized that this holds true, in general, only if the test item is based on a single step in the overall calculation. Multiple-choice items involving more than one step may, in some cases, have to be resorted to in order to allow the creation of a sufficient number of plausible distracters, but care must be exercised to ensure that distracters are not plausible for more than one reason if the nature of the error made (and hence the distracter chosen) is to affect the scoring of the test item.

Compiling tests

Whilst each examining authority may establish its own rules, the length of time which can be devoted to assessing the competence of candidates for certificates of competency is limited by practical, economic and other constraints. Therefore, a prime objective of those responsible for the organization and administration of the examination system is to find the most efficient, effective and economical method of assessing the competency of candidates.

An examination system should effectively test the breadth of a trainee's knowledge, understanding and proficiency of the subject areas pertinent to the tasks the trainee is expected to undertake. It is not possible to examine candidates fully in all areas. In effect, the examination samples a candidate's knowledge, understanding and proficiency by covering as wide a scope as is possible, within the time constraints, and testing the trainee's depth of knowledge, understanding and proficiency in selected areas.

The examination as a whole should assess each candidate's comprehension of principles, concepts and methodology; the trainee's ability to: apply principles, concepts and methodology; organize facts, ideas and arguments; and the trainee's abilities and skills in carrying out those tasks the trainee will be called upon to perform in the duties to be certificated to undertake.

All evaluation and testing techniques have their advantages and disadvantages. An examining authority should carefully analyse precisely what should and can be tested. A careful selection of test and evaluation methods should then be made to ensure that the best of the variety of techniques available today is used. Each test shall be that best suited to the learning outcome or ability to be tested.

Quality of test items

No matter which type of test is used, it is essential that all questions or test items used should be as brief as possible, since the time taken to read the questions themselves lengthens the examination. Questions must also be clear and complete. To ensure this, it is necessary that they be reviewed by a person other than the originator. No extraneous information should be incorporated into questions. In all cases, the questions should be checked to ensure that they measure an objective which is essential to the task concerned.

Use of rubrics

The assessor may consider the use of a rubric which describes the criteria that will be used to evaluate a specific task or operation. Rubrics allow assessors to communicate their expectations to the student being tested and allow students to self-check themselves on their progress as they progress towards the completion of their task or project. For the assessor, this increases the reliability of scores and increases the consistency of an assessor's assessment from student to student. In addition, when multiple assessors are grading students, rubrics also help improve the consistency of scoring of all of the assessors. Rubrics are usually written as an outline or a table that includes:

- Description of the task or project;
- Description of the criteria that are being used for the evaluation;
- Description of what constitutes particular performance level for each criterion;
- Examples of performance levels are Pass/Fail or Excellent/Good/Poor/Not attempted;
- Detailed description of each performance level for each criterion

Scoring tests

Scoring subjective tests

Assessment of seafarers is carried out to evaluate whether they have met specified learning objectives and be competent to perform the tasks for which they will take responsibility on board. They should be assessed against predetermined assessment criteria and in accordance with criteria for evaluation set out in the tables of competence in the STCW Code.

To achieve this in subjective tests, an analytical scoring scheme and complete model answers and relevant mark schemes should be produced for each question. The model answer should then be analysed for the definitions, facts, explanations, formulae, calculations, etc. contained in it and marks allocated to each item, the aim being to make the scoring as objective as possible. A subjective element will still exist in the original allocation of marks to the various sections and, to some extent, in the scoring of incomplete or partially correct sections.

Either credit scoring or deductive scoring may be used. In credit scoring, marks are awarded, in accordance with the scoring scheme, for each correctly completed part of the answer, no marks being credited for incorrect parts or omissions. With deductive scoring, marks are deducted for errors and omissions from the total mark for the question or part question (where a question has been divided into two or more sections). When applied to essay questions, the two methods should produce virtually the same score. Deductive scoring is usually confined to the marking of calculations.

Deductive scoring can be weighted to take account of the relative seriousness of different types of error. Errors are commonly classed and weighted as follows:

- errors of principle: for example, using the formula for righting moment in a calculation of list; deduct 50% of the mark for the question or part question;
- major errors: for example, extracting data for the wrong day or time from the nautical Almanac; deduct 30% of the mark for the question or part question; and
- clerical errors: for example, transposition of numbers from tables or question paper, careless arithmetic; deduct 10% of the mark for the question or part question for each error.

In the case of clerical errors, only one deduction for a single error should be made. No deductions are made for incorrect answers which follow through from the original error. If deductions exceed the total mark for a question or part question it is given a zero score; negative scores are not carried over to other parts.

The different types of errors can be taken into account in credit scoring schemes by suitably weighting the marks allocated to method, to the extraction of data and to clerical accuracy at each step of the calculation. The steps need to be smaller and more detailed than the division into parts used in deductive marking. As a result, the marks lost for errors of principle tend to be smaller in credit scoring than in deductive scoring.

A small percentage of the total mark, to be credited only for the correct final answer, is sometimes included in a credit scoring scheme. The answer must lie within stated accuracy limits to qualify for that credit. In deductive schemes, an answer that has otherwise been correctly calculated but which falls outside the accuracy limits is treated as a clerical error.

Where tests are to be marked locally at more than one test centre, a well-defined scoring scheme, which will give the same score when applied to the same paper by different markers, is essential for the uniform and fair treatment of candidates. To aid in any subsequent review of marks, possibly resulting from an appeal, the marker should make brief marginal notes on the paper to indicate the reasons for deductions. Guidance on the treatment of answers produced using calculators is needed.

Examination rules usually warn candidates that all working must be shown to gain full marks for questions. The marks to be deducted when insufficient working is shown but a correct answer is produced, or when all working is correctly shown but the answer is wrong, need to be known by the marker.

In papers in which all questions are to be answered, the marks may be weighted to reflect the importance or difficulty of individual questions or the length of time which will be needed to answer them. When this is done, it is usual to indicate the mark for each question on the question paper. Optional questions should all be of similar standard and carry equal marks, so that the standard of the complete test is the same regardless of the questions chosen.

Use can be made of a compulsory and an optional section in the same paper. Questions on which it is felt that all candidates should be tested can be placed in the compulsory section and suitably weighted, while the remainder of the paper offers a choice of questions each of similar standards.

A problem that arises with optional papers is how to deal with cases where more than the required number of questions is answered. Various solutions are adopted by different examining boards. Many mark all questions and discard the lowest marked question or questions; although that fact is not generally advertised as it may encourage candidates to attempt extra questions. Others take the requisite number of answers in the order in which they are on the question paper and ignore the remainder. A similar problem arises in papers in which candidates are required to answer a given number of questions and including at least some stated number from each of several sections.

The pass mark should be set at the lowest score for which sufficient skills and knowledge is demonstrated for competency in each subject. In practice, that score is difficult to determine exactly for an individual paper and could vary slightly from one examination to another. Such an arrangement would be difficult to administer and would be considered unfair by candidates, so the pass mark is fixed and published in the examination regulations. It is, therefore, essential when preparing papers to maintain as constant a standard as possible, such that the pass mark is an appropriate measure of competency.

The following instructions are typical of those produced for guidance of examiners on the marking of examinations:

In order to achieve uniformity in marking between the examiners in various centres and to facilitate the review of papers, the following guidelines are to be used at all centres:

1 When several candidates write the same examination, papers, other than multiple choice, should be marked question by question, that is to say, question 1 of paper 1 should be marked for all applicants before proceeding to question 2, etc. This gives more uniform marking.

2 All questions should be marked even if it becomes apparent that the candidate cannot achieve the pass mark.

3 Neatness and orderly layout of work:

Where work is not properly laid out or is not neat, marks should be deducted without regard to correctness of the answer. The number of marks deducted should vary according to the quality of the work up to a maximum of 10% where the correct answer is obtained.

4 Important nautical and technical terms:

Where, in general calculations or general questions, an incorrect term is used and such a term is incidental to the work, the examiner should exercise his judgement as to whether or not marks should be deducted, but in any case, a deduction should not exceed 10% of the allotted marks. This does not apply to direct answers involving definitions or in answers involving the naming of parts.

5 Types of errors:

Errors can be divided into three types:

(a) P – error in principle; 50% of marks allotted for the whole or part of the question should be deducted;

(b) C – clerical error; 10% of the marks allocated should be deducted for each such error; and

(c) M – major error; 30% of the marks allotted for the question or part of the question should be deducted.

Note: Large mark questions should be considered in their main sections and percentages of the sections deducted. Candidates should be given the benefit of any doubt which may exist.

6 Drawings:

Too much importance should not be attached to elaborate drawings. Often a simple sketch with captions is very explanatory and indicative of a good understanding.

7 Incomplete answers:

Where a problem or distinct section of a large problem is only partly worked and a step of principle remains to be made, marks allotted should not exceed 50% of the total marks or the split marks allotted, as the case may be.

8 Marking papers:

When marking papers, examiners should enter appropriate marginal notes in brief showing why marks have been deducted, using abbreviations in paragraph 5. The actual error should be ringed and marked with a brief statement of the reason for the error, e.g. 'wrong day'. A paper should be so marked that any reviewing examiner can see at a glance just what happened, including a marginal note to indicate award of a 'benefit of doubt'.

9 Accuracy:

The following is a general rule to examiners of the degree of accuracy expected:

(a) in calculating a ship's position, ±0.5 minutes of arc and to the nearest second of time;

(b) for a position line, to within 0.5 of a mile of the true result;

(c) in calculating compass errors, bearings and courses, ±0.5 of a degree;

(d) distances within 0.5 of a mile and times of meridian passage, to the nearest minute; and

(e) tidal prediction, to ± 15 cm.

10 In the case of marginal failure, the paper concerned should be carefully reviewed.

This review is not to be regarded as having the purpose of passing the candidate; it is to ensure that the foregoing marking standards have been correctly applied and are consistent with those of other responses to the same examination. It may result in either an increase or a decrease in marks assigned. This review having been completed, the examiner should issue a fail result if it is still below the pass mark.

11 Use of calculators:

When a non-programmable calculator is used by a candidate in an examination, all necessary formulae and transpositions must be shown for full marks to be allotted. In the case of a correctly set out answer, or partial answer, which has an incorrect final result, 30% of the whole or part should be deducted on the major error rule.

The evaluation could consist of oral and practical tests which many topics may require as per the table A-III/5 of the STCW Code, column 2 on Knowledge, understanding and proficiency. In such cases, the following should be taken into consideration:

1 *Advantages and disadvantages of oral and practical tests*

It is generally considered advisable that candidates for certificates of competency should also be examined orally. Some aspects of competency can only be properly judged by having the candidate demonstrate the ability to perform specific tasks in a safe and efficient manner. The safety of the ship and the protection of the marine environment are heavily dependent on the human element. The ability of candidates to react in an organized, systematic and prudent way can be more easily and reliably judged through an oral/practical test incorporating the use of models or simulators than by any other form of test.

One disadvantage of oral/practical tests is that they can be time-consuming, as each test may take up about one to two hours if it is to comprehensively cover the topics concerned. Relevant equipment would also need to be made available for the competences that are to be tested. Some items of equipment could be dedicated solely for use in examinations.

2 *Feedback*

In order to keep the training programme up to date in the future, it is essential for users to provide feedback. Objective and positive critical comments and new information would facilitate the enhancement of the quality of the model course, and would promote better training in safety and security at sea, and protection of the marine environment. Such feedback, information, comments and suggestions should be sent to the Head, Maritime Training and Human Element, IMO.

Appendix 1
Sample of an assessment plan

STCW Code:	Section A-III/7	*Table:*	Table A-III/7
Approved training programme:	Electro-technical rating	*Instructor:*	*Date prepared:*
Resources needed	**(indicate resources needed)**	*Assessor:*	*Approved by:*

Function 1: Electrical, electronic and control engineering at the support level

Topics	**Written assessment**				**Practical assessment**						
					Assessment task						
	No. of test items	**Assess-ment method**	**Assessment period**	**Grading scheme**	Safety instructions of electrical equipment and machinery	Risks associated with high-voltage equipment and on-board work	Operation of equipment and system	Safety procedure	Test equipment	Repair and maintenance	**Grading scheme**
					Assessment criteria						
1 Function Introduction	1	Multiple choice questions	Administered at the end of the training	Earned at least 75% correct responses	Observes safety procedures prior to work commencing on shipboard electrical systems, machinery and equipment	Evaluates risks associated with working on high-voltage equipment	Operation of electrical equipment and system is in accordance with manufacturer's manual. Identifies operational parameters of a particular equipment and system. Describes acceptable performance levels of the parameters monitored on equipment and systems	Procedures for recognizing and avoiding electrical shock hazards and first aid procedures for electrical shock are observed when working with equipment and systems	Uses appropriate test equipment in monitoring parameters of equipment and system	Applies procedures for repairing and maintaining equipment and system based on instruction manual	Successfully meets all assessment criteria in the given assessment tasks

Topics	Written assessment				Practical assessment						
					Assessment task						
	No. of test items	Assess-ment method	Assessment period	Grading scheme	Safety instructions of electrical equipment and machinery	Risks associated with high-voltage equipment and on-board work	Operation of equipment and system	Safety procedure	Test equipment	Repair and maintenance	Grading scheme
					Assessment criteria						
2 Safe use of electrical equipment											
2.1 Safe use and operation of electrical equipment											
.1 Safety precautions	1										
.2 Isolation procedures	2										
.3 Emergency procedures	1										
.4 Voltage levels	1										
2.2 Electric shock											
.1 Causes of electric shock	1										
.2 Precautions to prevent electric shock	1										

Topics	Written assessment				Practical assessment						
					Assessment task						
	No. of test items	Assessment method	Assessment period	Grading scheme	Safety instructions of electrical equipment and machinery	Risks associated with high-voltage equipment and on-board work	Operation of equipment and system	Safety procedure	Test equipment	Repair and maintenance	Grading scheme
					Assessment criteria						
3 Operation of electrical systems and machinery											
3.1 Mechanical engineering systems											
.1 Prime movers and propulsion plant	6										
.2 Engine-room auxiliary machineries	6										
.3 Steering systems	2										
.4 Cargo-handling systems	2										
.5 Deck machineries	2										
.6 Hotel systems	2										

Topics	Written assessment				Practical assessment						
					Assessment task						
	No. of test items	Assessment method	Assessment period	Grading scheme	Safety instructions of electrical equipment and machinery	Risks associated with high-voltage equipment and on-board work	Operation of equipment and system	Safety procedure	Test equipment	Repair and maintenance	Grading scheme
					Assessment criteria						
3.2 Electrical engineering systems											
.1 Electro-technology and electrical machines theory	8										
.2 Electrical power distribution boards and electrical equipment	8										
.3 Fundamentals of automation, automatic control systems and technology	11										
.4 Instrumentation, alarm and monitoring systems	7										
.5 Electrical drives	7										
.6 Electro-hydraulic and electro-pneumatic control systems	9										
.7 Coupling, load sharing and changes in electrical configuration	7										

Topics	Written assessment				Practical assessment						
					Assessment task						
	No. of test items	Assessment method	Assessment period	Grading scheme	Safety instructions of electrical equipment and machinery	Risks associated with high-voltage equipment and on-board work	Operation of equipment and system	Safety procedure	Test equipment	Repair and maintenance	Grading scheme
					Assessment criteria						
4 Hand tools, electrical and electronic measurement equipment											
4.1 Safety requirements for working on shipboard electrical systems	1										
4.2 Safe working practices	1										
4.3 Construction and operational characteristics of shipboard AC and DC systems and equipment	2										
4.4 Use of measuring instruments, machine tools and hand and power tools	11										
Total	**100**										

STCW Code:	Section A-III/7	*Table:*	Table A-III/7
Approved training programme:	Electro-technical rating	*Instructor:*	*Date prepared:*
Resources needed	**(indicate resources needed)**	*Assessor:*	*Approved by:*

Function 2: Maintenance and repair at the support level

Topics	**Written assessment**				**Practical assessment**				
					Assessment Task				
	No. of test items	**Assessment method**	**Assessment period**	**Grading scheme**	Maintenance activities	Use of equipment and tools	Interprets technical drawings	Isolation, dismantling and reassembly of plant and equipment	**Grading scheme**
					Assessment criteria				
1 Function introduction	1	Multiple choice questions	Administered at the end of the training	Earns at least 75% correct responses	Maintenance tasks are carried out in accordance with technical, safety and procedural specifications	Selection of equipment and tools to be used is appropriate to the task to be undertaken. Use of the equipment and tools is in accordance with instruction manual	Ship's technical drawings are accurately interpreted in accordance with technical specifications.	Performance of isolation, dismantling and reassembly tasks of plant and equipment is in accordance with manufacturer's safety guidelines and shipboard instructions	Successfully meets all assessment criteria in the given assessment tasks
2 Shipboard Maintenance and Repair									
2.1 Lubrication and cleaning materials and equipment	2								
2.2 Safe disposal of waste materials	2								
2.3 Routine maintenance and repair procedures	3								
2.4 Manufacturer's safety guidelines and shipboard instructions	3								

Topics	Written assessment				Practical assessment				
					Assessment Task				
	No. of test items	Assessment method	Assessment period	Grading scheme	Maintenance activities	Use of equipment and tools	Interprets technical drawings	Isolation, dismantling and reassembly of plant and equipment	Grading scheme
					Assessment criteria				
3 Maintenance and repair of electrical systems and machinery									
3.1 Electro-technical drawings and safe isolation of equipment and associated systems	5								
3.2 Testing, detecting faults and maintaining and restoring electrical control equipment and machinery	8								
3.3 Electrical and electronic equipment operating in flammable areas	5								
3.4 Ship's fire-detection system	3								
3.5 Maintenance and repair procedures									
3.6 Detecting machinery malfunction, location of faults and action to prevent damage	5								
3.7 Maintenance and repair of lighting fixtures and supply systems	3								
Total	**40**								

STCW Code:	Section A-III/7	*Table:*	Table A-III/7
Approved Training Programme:	Electro-technical Rating	*Instructor:*	*Date Prepared:*
Resources Needed	**(indicate resources needed)**	*Assessor:*	*Approved by:*

Function 3: Controlling the operation of the ship and care for persons on board at the support level

Topics	**Written assessment**				**Practical assessment**				
					Assessment task				
	No. of test items	**Assess-ment method**	**Assessment period**	**Grading scheme**	Store stowage operation	Handling of dangerous, hazardous and harmful stores	Safeguarding marine environment	Safe working practices	**Grading scheme**
					Assessment criteria				
1 Function introduction	1	Multiple Choice Questions	Administered at the end of the training	Earns at least 75% correct responses	Stowing of stores and performed based on established safety procedures and practices and with the equipment's operating instructions.	Handling of dangerous, hazardous and harmful stores is in accordance with established safety practices.	Procedures in place designed to safeguard marine environment are observed at all times and in the performance of assigned tasks.	Procedures designed to safeguard personnel and the ship are observed at all times. Safe working practices are observed and appropriate safety and protective equipment is correctly used at all times	Successfully meets all assessment criteria in the given assessment tasks
2 Handling, stowing and securing of stores	2								
3 Prevention of pollution of the marine environment									
3.1 Precautions to prevent pollution of the marine environment	2								
3.2 Use and operation of anti-pollution equipment/agents	5								
3.3 Approved methods for disposal of marine pollutants	2								

Topics	Written assessment				Practical assessment				
					Assessment task				
	No. of test items	**Assess-ment method**	**Assessment period**	**Grading scheme**	Store stowage operation	Handling of dangerous, hazardous and harmful stores	Safeguarding marine environment	Safe working practices	**Grading scheme**
					Assessment criteria				
4 Occupational health and safety procedures									
4.1 Safe working practices and personal shipboard safety									
.1 Electrical safety	2								
.2 Lockout/tag-out	2								
.3 Mechanical safety	2								
.4 Permit to work systems	2								
.5 Working aloft	2								
.6 Working in enclosed spaces	2								
.7 Lifting techniques and methods of preventing back injury	2								
.8 Chemical and biohazard safety	2								
.9 Personal safety equipment	2								
Total	**30**								

Part 1: Preparation

1 Introduction

1.1 The success of any enterprise depends heavily on sound and effective preparations.

1.2 Although the IMO model course *package* has been made as comprehensive as possible, it is nonetheless vital that sufficient time and resources are devoted to preparation. Preparation not only involves matters concerning administration or organization, but also includes the preparation of any course notes, drawings, sketches, overhead transparencies, etc., which may be necessary.

2 General considerations

2.1 The course *package* should be studied carefully; in particular, the course syllabus and associated material must be attentively and thoroughly studied. This is vital if a clear understanding is to be obtained of what is required, in terms of resources necessary to successfully implement the course.

2.2 A *checklist*, such as that set out in annex A1, should be used throughout all stages of preparation to ensure that all necessary actions and activities are being carried out in good time and in an effective manner. The checklist allows the status of the preparation procedures to be monitored, and helps in identifying the remedial actions necessary to meet deadlines. It will be necessary to hold meetings of all those concerned in presenting the course from time to time in order to assess the status of the preparation and *troubleshoot* any difficulties.

2.3 The course syllabus should be discussed with the teaching staff who are to present the course, and their views received on the particular parts they are to present. A study of the syllabus will determine whether the incoming trainees need preparatory work to meet the entry standard. The detailed teaching syllabus is constructed in *training outcome* format. Each specific outcome states precisely what the trainee must do to show that the outcome has been achieved. An example of a model course syllabus is given in annex A2. Part 3 deals with curriculum development and explains how a syllabus is constructed and used.

2.4 The teaching staff who are to present the course should construct notes or lesson plans to achieve these outcomes. A sample lesson plan for one of the areas of the sample syllabus is provided in annex A3.

2.5 It is important that the staff who present the course convey, to the person in charge of the course, their assessment of the course as it progresses.

3 Specific considerations

3.1 *Scope of course*

In reviewing the scope of the course, the instructor should determine whether it needs any adjustment in order to meet additional local or national requirements (*see* **Part 3**).

3.2 *Course objective*

.1 The course objective, as stated in the course material, should be very carefully considered so that its meaning is fully understood. Does the course objective require expansion to encompass any additional task that national or local requirements will impose upon those who successfully complete the course? Conversely, are there elements included which are not validated by national industry requirements?

.2 It is important that any subsequent assessment made of the course should include a review of the course objectives.

3.3 *Entry standards*

.1 If the entry standard will not be met by your intended trainee intake, those entering the course should first be required to complete an upgrading course to raise them to the stated entry level. Alternatively, those parts of the course affected could be augmented by inserting course material which will cover the knowledge required.

.2 If the entry standard will be exceeded by your planned trainee intake, you may wish to abridge or omit those parts of the course the teaching of which would be unnecessary, or which could be dealt with as revision.

.3 Study the course material with the above questions in mind and with a view to assessing whether or not it will be necessary for the trainees to carry out preparatory work prior to joining the course. Preparatory material for the trainees can range from refresher notes, selected topics from textbooks and reading of selected technical papers, through to formal courses of instruction. It may be necessary to use a combination of preparatory work and the model course material in modified form. It must be emphasized that where the model course material involves an international requirement, such as a regulation of the International Convention on Standards of Training, Certification and Watchkeeping (STCW) 1978, as amended, the standard must not be relaxed; in many instances, the intention of the Convention is to require review, revision or increased depth of knowledge by candidates undergoing training for higher certificates.

3.4 *Course certificate, diploma or document*

Where a certificate, diploma or document is to be issued to trainees who successfully complete the course, ensure that this is available and properly worded and that the industry and all authorities concerned are fully aware of its purpose and intent.

3.5 *Course intake limitations*

.1 The course designers have recommended limitations regarding the numbers of trainees who may participate in the course. As far as possible, these limitations should not be exceeded; otherwise, the quality of the course will be diluted.

.2 It may be necessary to make arrangements for accommodating the trainees and providing facilities for food and transportation. These aspects must be considered at an early stage of the preparations.

3.6 *Staff requirements*

.1 It is important that an experienced person, preferably someone with experience in course and curriculum development, is given the responsibility of implementing the course.

.2 Such a person is often termed a *course coordinator* or *course director*. Other staff, such as lecturers, instructors, laboratory technicians, workshop instructors, etc., will be needed to implement the course effectively. Staff involved in presenting the course will need to be properly briefed about the course work they will be dealing with, and a system must be set up for checking the material they may be required to prepare. To do this, it will be essential to make a thorough study of the syllabus and apportion the parts of the course work according to the abilities of the staff called upon to present the work.

.3 The person responsible for implementing the course should consider monitoring the quality of teaching in such areas as variety and form of approach, relationship with trainees, and communicative and interactive skills; where necessary, this person should also provide appropriate counselling and support.

3.7 *Teaching facilities and equipment*

.1 *Rooms and other services*

It is important to make reservations as soon as is practicable for the use of lecture rooms, laboratories, workshops and other spaces.

.2 *Equipment*

Arrangements must be made at an early stage for the use of equipment needed in the spaces mentioned in 3.7.1 to support and carry through the work of the course. For example:

- writing boards and materials
- apparatus in laboratories for any associated demonstrations and experiments

- machinery and related equipment in workshops
- equipment and materials in other spaces (e.g. for demonstrating firefighting, personal survival, etc.)

3.8 *Teaching aids*

Any training aids specified as being essential to the course should be constructed, or checked for availability and working order.

3.9 *Audiovisual aids*

Audiovisual aids (AVA) may be recommended in order to reinforce the learning process in some parts of the course. Such recommendations will be identified in Part A of the model course. The following points should be borne in mind:

.1 *Overhead projectors*

Check through any illustrations provided in the course for producing overhead projector (OHP) transparencies, and arrange them in order of presentation. To produce transparencies, a supply of transparency sheets is required; the illustrations can be transferred to these via photocopying. Alternatively, transparencies can be produced by writing or drawing on the sheet. Coloured pens are useful for emphasizing salient points. Ensure that spare projector lamps (bulbs) are available.

.2 *Slide projectors*

If you order slides indicated in the course framework, check through them and arrange them in order of presentation. Slides are usually produced from photographic negatives. If further slides are considered necessary and cannot be produced locally, OHP transparencies should be resorted to.

.3 *Cine projector*

If films are to be used, check their compatibility with the projector (i.e. 16 mm, 35 mm, sound, etc.). The films must be test-run to ensure there are no breakages.

.4 *Video equipment*

It is essential to check the type of video tape to be used. The two types commonly used are VHS and Betamax. Although special machines exist which can play either format, the majority of machines play only one or the other type. Note that VHS and Betamax are not compatible; the correct machine type is required to match the tape. Check also that the TV raster format used in the tapes (i.e. number of lines, frames/second, scanning order, etc.) is appropriate to the TV equipment available. (Specialist advice may have to be sought on this aspect.) All video tapes should be test-run prior to their use on the course.

.5 *Computer equipment*

If computer-based aids are used, check their compatibility with the projector and the available software.

.6 *General note*

The electricity supply must be checked for correct voltage, and every precaution must be taken to ensure that the equipment operates properly and safely. It is important to use a proper screen which is correctly positioned; it may be necessary to exclude daylight in some cases. A check must be made to ensure that appropriate screens or blinds are available. All material to be presented should be test-run to eliminate any possible troubles, arranged in the correct sequence in which it is to be shown, and properly identified and cross-referenced in the course timetable and lesson plans where appropriate.

3.10 *IMO references*

The content of the course, and therefore its standard, reflects the requirements of all the relevant IMO international conventions and the provisions of other instruments as indicated in the model course. The relevant publications can be obtained from the Publication Service of IMO, and should be available, at least to

those involved in presenting the course, if the indicated extracts are not included in a compendium supplied with the course.

3.11 *Textbooks*

The detailed syllabus may refer to a particular textbook or textbooks. It is essential that these books are available to each student taking the course. If supplies of textbooks are limited, a copy should be loaned to each student, who will return it at the end of the course. Again, some courses are provided with a compendium which includes all or part of the training material required to support the course.

3.12 *Bibliography*

Any useful supplementary source material is identified by the course designers and listed in the model course. This list should be supplied to the participants so that they are aware where additional information can be obtained, and at least two copies of each book or publication should be available for reference in the training institute library.

3.13 *Timetable*

Model courses are developed providing a recommended range in duration of time for lectures, demonstrations, laboratories or simulator exercises and assessment. No formal timetable is included in model courses.

Instructors should develop their own timetable depending on:

- **.1** the level of skills of trainees;
- **.2** the numbers to be trained;
- **.3** the number of instructors;
- **.4** simulator facilities and equipment available, and
- **.5** normal practices at the training establishment.

Part 2: Notes on teaching technique

1 Preparation

1.1 Identify the section of the syllabus which is to be dealt with.

1.2 Read and study thoroughly all the syllabus elements.

1.3 Obtain the necessary textbooks or reference papers which cover the training area to be presented.

1.4 Identify the equipment which will be needed, together with support staff necessary for its operation.

1.5 It is essential to use a *lesson plan*, which can provide a simplified format for coordinating lecture notes and supporting activities. The lesson plan breaks the material down into identifiable steps, making use of brief statements, possibly with keywords added, and indicating suitable allocations of time for each step. The use of audiovisual material should be indexed at the correct point in the lecture with an appropriate allowance of time. The audiovisual material should be test-run prior to its being used in the lecture. An example of a lesson plan is shown in annex A3.

1.6 The syllabus is structured in training outcome format and it is thereby relatively straight forward to assess each trainee's grasp of the subject matter presented during the lecture. Such assessment may take the form of further discussion, oral questions, written tests or selection-type tests, such as multiple-choice questions, based on the objectives used in the syllabus. Selection-type tests and short-answer tests can provide an objective assessment independent of any bias on the part of the assessor. For certification purposes, assessors should be appropriately qualified for the particular type of training or assessment.

REMEMBER – POOR PREPARATION IS A SURE WAY TO LOSE THE INTEREST OF A GROUP

1.7 Check the rooms to be used before the lecture is delivered. Make sure that all the equipment and apparatus are ready for use and that any support staff are also prepared and ready. In particular, check that all blackboards are clean and that a supply of writing and cleaning materials is readily available.

2 Delivery

2.1 Always face the people you are talking to; never talk with your back to the group.

2.2 Talk clearly and sufficiently loudly to reach everyone.

2.3 Maintain eye contact with the whole group as a way of securing their interest and maintaining it (i.e. do not look continuously at one particular person, nor at a point in space).

2.4 People are all different, and they behave and react in different ways. An important function of an instructor is to maintain interest and interaction between members of a group.

2.5 Some points or statements are more important than others and should therefore be emphasized. To ensure that such points or statements are remembered, they must be restated a number of times, preferably in different words.

2.6 If a blackboard is to be used, any writing on it must be clear and large enough for everyone to see. Use colour to emphasize important points, particularly in sketches.

2.7 It is only possible to maintain a high level of interest for a relatively short period of time; therefore, break the lecture up into different periods of activity to keep interest at its highest level. Speaking, writing, sketching, use of audiovisual material, questions, and discussions can all be used to accomplish this. When a group is writing or sketching, walk amongst the group, looking at their work, and provide comment or advice to individual members of the group when necessary.

2.8 When holding a discussion, do not allow individual members of the group to monopolize the activity, but ensure that all members have a chance to express opinions or ideas.

2.9 If addressing questions to a group, do not ask them collectively; otherwise, the same person may reply each time. Instead, address the questions to individuals in turn, so that everyone is invited to participate.

2.10 It is important to be guided by the syllabus content and not to be tempted to introduce material which may be too advanced, or may contribute little to the course objective. There is often competition between instructors to achieve a level which is too advanced. Also, instructors often strongly resist attempts to reduce the level to that required by a syllabus.

2.11 Finally, effective preparation makes a major contribution to the success of a lecture. Things often go wrong; preparedness and good planning will contribute to putting things right. Poor teaching cannot be improved by good accommodation or advanced equipment, but good teaching can overcome any disadvantages that poor accommodation and lack of equipment can present.

Part 3: Curriculum development

1 Curriculum

The dictionary defines curriculum as a *regular course of study*, while syllabus is defined as a *concise statement of the subjects forming a course of study*. Thus, in general terms, a curriculum is simply a course, while a syllabus can be thought of as a list (traditionally, a *list of things to be taught*).

2 Course content

The subjects which are needed to form a training course, and the precise skills and depth of knowledge required in the various subjects, can only be determined through an in-depth assessment of the job functions which the course participants are to be trained to perform (job analysis). This analysis determines the training needs, hence the purpose of the course (course objective). After ascertaining this, it is possible to define the scope of the course.

(**Note:** Determination of whether or not the course objective has been achieved may quite possibly entail assessment, over a period of time, of the *on-the-job performance* of those completing the course. However, the detailed learning objectives are quite specific and immediately assessable.)

3 Job analysis

A job analysis can only be properly carried out by a group whose members are representative of the organizations and bodies involved in the area of work to be covered by the course. The validation of results, via review with persons currently employed in the job concerned, is essential if undertraining and overtraining are to be avoided.

4 Course plan

Following definition of the course objective and scope, a course plan or outline can be drawn up. The potential students for the course (the trainee target group) must then be identified, the entry standard to the course decided and the prerequisites defined.

5 Syllabus

The final step in the process is the preparation of the detailed syllabus with associated timescales; the identification of those parts of textbooks and technical papers which cover the training areas to a sufficient degree to meet, but not exceed, each learning objective; and the drawing up of a bibliography of additional material for supplementary reading.

6 Syllabus content

The material contained in a syllabus is not static; technology is continuously undergoing change and there must therefore be a means for reviewing course material in order to eliminate what is redundant and introduce new material reflecting current practice. As defined above, a syllabus can be thought of as a list and, traditionally, there have always been an *examination syllabus* and a *teaching syllabus*; these indicate, respectively, the subject matter contained in an examination paper, and the subject matter a teacher is to use in preparing lessons or lectures.

7 Training outcomes

7.1 The prime communication difficulty presented by any syllabus is how to convey the *depth* of knowledge required. A syllabus is usually constructed as a series of *training outcomes* to help resolve this difficulty.

7.2 Thus, curriculum development makes use of training outcomes to ensure that a common minimum level and breadth of attainment is achieved by all the trainees following the same course, irrespective of the training institution (i.e. teaching/lecturing staff).

7.3 Training outcomes are trainee-oriented, in that they describe an end result which is to be achieved by the trainee as a result of a learning process.

7.4 In many cases, the learning process is linked to a skill or work activity and, to demonstrate properly the attainment of the objective, the trainee response may have to be based on practical application or use, or on work experience.

7.5 The training outcome, although aimed principally at the trainee to ensure achievement of a specific learning step, also provides a framework for the teacher or instructor upon which lessons or lectures can be constructed.

7.6 A training outcome is specific and describes precisely what a trainee must do to demonstrate his knowledge, understanding or skill as an end product of a learning process.

7.7 The learning process is the *knowledge acquisition* or *skill development* that takes place during a course. The outcome of the process is an acquired *knowledge, understanding, skill*; but these terms alone are not sufficiently precise for describing a training outcome.

7.8 Verbs, such as *calculates, defines, explains, lists, solves* and *states*, must be used when constructing a specific training outcome, so as to define precisely what the trainee will be enabled to do.

7.9 In the IMO model course project, the aim is to provide a series of model courses to assist instructors in developing countries to enhance or update the maritime training they provide, and to allow a common minimum standard to be achieved throughout the world. The use of training outcomes is a tangible way of achieving this desired aim.

7.10 As an example, a syllabus in training-outcome format for the subject of ship construction appears in annex A2. This is a standard way of structuring this kind of syllabus. Although, in this case, an outcome for each area has been identified – and could be used in an assessment procedure – this stage is often dropped to obtain a more compact syllabus structure.

8 Assessment

Training outcomes describe an outcome which is to be achieved by the trainee. Of equal importance is the fact that such an achievement can be measured OBJECTIVELY through an evaluation which will not be influenced by the personal opinions and judgements of the examiner. Objective testing or evaluation provides a sound base on which to make reliable judgements concerning the levels of understanding and knowledge achieved, thus allowing an effective evaluation to be made of the progress of trainees in a course.

Annex A1 – Preparation checklist

Ref	Component	Identified	Reserved	Electricity supply	Purchases	Tested	Accepted	Started	Finished	Status OK
1	Course plan									
2	Timetable									
3	Syllabus									
4	Scope									
5	Objective									
6	Entry standard									
7	Preparatory course									
8	Course certificate									
9	Participant numbers									
10	Staffing:									
	Coordinator									
	Lecturers									
	Instructors									
	Technicians									
	Other									

Annex A1 – Preparation checklist *(continued)*

Ref	Component	Identified	Reserved	Electricity supply	Purchases	Tested	Accepted	Started	Finished	Status OK
11	Facilities									
	a) Rooms									
	Lab									
	Workshop									
	Other									
	Class									
	b) Equipment									
	Lab									
	Workshop									
	Other									
12	AVA									
	Equipment and materials									
	OHP									
	Slide									
	Cine									
	Video									
13	IMO reference									
14	Textbooks									
15	Bibliography									

Annex A2 – Example of a model course syllabus in a subject area

Subject area: Ship construction

Prerequisite: Have a broad understanding of shipyard practice

General aims: Have knowledge of materials used in shipbuilding, specification of shipbuilding steel and process of approval

Textbooks: No specific textbook has been used to construct the syllabus, but the instructor would be assisted in preparation of lecture notes by referring to suitable books on ship construction, such as *Ship Construction* by Eyres (T12) and *Merchant Ship Construction* by Taylor (T58)

Course outline		
Knowledge, understanding and proficiency	**Total hours for each topic**	**Total hours for each subject area of Required performance**
Competence :		
3.1 Control trim, stability and stress		
3.1.1 Fundamental principles of ship construction, trim and stability		
.1 Shipbuilding materials		
.2 Welding		
.3 Bulkheads		
.4 Watertight and weathertight doors		
.5 Corrosion and its prevention		
.6 Surveys and dry-docking		
.7 Stability		

Part C3: Detailed Outline

Introduction

The detailed outline is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

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.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed training syllabus; in particular:

- Teaching aids (indicated by A)
- IMO references (indicated by R), and
- Textbooks (indicated by T)

will provide valuable information to instructors.

Explanation of information contained in the syllabus tables

The information on each table is systematically organized in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of COMPETENCES. Each competence is uniquely and consistently numbered on this model course.

In this function the competence is **Control Trim, Stability and Stress**. It is numbered 3.1, that is the first competence in Function 3. The term "competence" should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the above competence comprises three training outcomes. The first is concerned with FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY. Each training outcome is uniquely and consistently numbered in this model course. That concerned with fundamental principles of ship construction, trim and stability is uniquely numbered 3.1.1. For clarity, training outcomes are printed in black type on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with the fundamental principles of ship construction, trim and stability there are three areas of performance. These are:

3.1.1.1 *Shipbuilding materials*

3.1.1.2 *Welding*

3.1.1.3 *Bulkheads*

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the

teaching process. For example, under the topic 3.1.1.1, to meet the Required performance, the trainee should be able to:

- state that steels are alloys of iron, with properties dependent upon the type and amount of alloying materials used
- state that the specification of shipbuilding steels are laid down by classification societies
- state that shipbuilding steel is tested and graded by classification society surveyors who stamp it with approved marks

and so on.

IMO references (Rx) are listed in the column to the right-hand side. Teaching aids (Ax), videos (Vx) and textbooks (Tx) relevant to the training outcome and Required performance are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organized to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organized to match with the competence in the STCW Code, table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for shipbuilding materials to be studied before stability. What is necessary is that all of the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

FUNCTION 3: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE MANAGEMENT LEVEL

COMPETENCE 3.1	**Control trim, stability and stress**	**IMO reference**

Competence :

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY

Textbooks: T11, T12, T35, T58, T69

Teaching aids: A1, A4, V5, V6, V7

Required performance:

1.1 Shipbuilding materials (3 hours)

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used — R1
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification surveyors, who stamp it with approved marks
- explains that mild steel, graded A – E, is used for most parts of the ship
- states why higher tensile steel may be used in areas of high stress, such as the sheer strake
- explains that the use of higher tensile steel in place of mild steel results in saving of weight for the same strength
- explains what is meant by:
  - tensile strength
  - ductility
  - hardness
  - toughness
- defines strain as extension divided by original length
- sketches a stress-strain curve for mild steel
- explains
  - yield point
  - ultimate tensile stress
  - modulus of elasticity
- explains that toughness is related to the tendency to brittle fracture
- explains that stress fracture may be initiated by a small crack or notch in a plate
- states that cold conditions increase the chances of brittle fracture
- states why mild steel is unsuitable for the very low temperatures involved in the containment of liquefied gases
- lists examples where castings or forgings are used in ship construction
- explains the advantages of the use of aluminium alloys in the construction of superstructures
- states that aluminium alloys are tested and graded by classification society surveyors
- explains how strength is preserved in aluminium superstructures in the event of fire
- describes the special precautions against corrosion that are needed where aluminium alloy is connected to steelwork

Annex A3 – Example of a lesson plan for annex A2

Subject area: 3.1 Control trim, stability and stress **Lesson Number: 1** **Duration: 3 hours**

Training Area: 3.1.1 Fundamental principles of ship construction, trim and stability

Main element Specific training outcome in teaching sequence, with memory keys	**Teaching method**	**Textbook**	**IMO reference**	**A/V aid**	**Instructor guidelines**	**Lecture notes**	**Time (minutes)**
1.1 Shipbuilding materials (3 hours)							
States that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	10
States that the specifications of shipbuilding steels are laid down by classification societies	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	20
Explains that mild steel, graded A to E, is used for most parts of the ship	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	15
States why higher tensile steel may be used in areas of high stress, such as the sheer strake	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	10
Explains that use of higher tensile steel in place of mild steel results in a saving of weight for the same strength	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	15