

MARINE ENVIRONMENT PROTECTION
COMMITTEE
65th session
Agenda item 4

MEPC 65/INF.17
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AIR POLLUTION AND ENERGY EFFICIENCY

Update of the draft IMO model course on energy-efficient operation of ships

Note by the Secretariat

SUMMARY

<i>Executive summary:</i>	This document provides an updated version of the draft IMO Model Course on energy-efficient operation of ships
<i>Strategic direction:</i>	7.3
<i>High-level action:</i>	7.3.2
<i>Planned output:</i>	7.3.2.1
<i>Action to be taken:</i>	Paragraph 5
<i>Related documents:</i>	MEPC 63/23, MEPC 63/4/5, MEPC 64/4/5 and MEPC 64/INF.3

Background

1 MEPC 64 considered documents MEPC 64/4/5 and MEPC 64/INF.3 (Secretariat) notifying that the World Maritime University (WMU) had finalized the draft Model Course for energy-efficient operation of ships, and reporting progress on the development of the draft IMO Model Course on energy-efficient operation of ships.

2 MEPC 64 agreed to request the Secretariat to forward the draft IMO Model Course on energy-efficient operation of ships to validation group for model courses under the STCW convention to review and provide comments.

3 The Secretariat forwarded the draft IMO Model Course to the validation group and received the following comments:

- .1 The draft Model Course with 5-days duration is too long compared with a similar course prepared by classification societies, which is only two days;
- .2 Considering that ship management both on board and on shore are the target participants of the course, EEDI and EEOI should be thoroughly discussed and actual calculation is a must; and

- .3 Impact of speed to fuel consumption cannot fully be appreciated using the full mission engine-room simulator (sample exercise IV). It is better to complement the simulator exercise using actual fuel consumption of existing vessel type data at various speed to be calculated by the participants.

4 Taking into account the above comments from the validation group, the Secretariat adjusted the draft Model Course by adding some paragraphs in the relevant sections, as set out in annex to this document. Proposed additions are shown by underlining.

Action requested of the Committee

5 The Committee is invited to note the information provided and take action as appropriate.

ANNEX

MODEL COURSE

4. 05

ENERGY EFFICIENT OPERATION OF SHIPS

Final DRAFT

Updated by IMO Marine Environment Division in February 2013 to adjust the course, taking into account comments from validation group for model courses under the STCW convention

December 2011

World Maritime University

Introduction

■ Purpose of the model courses

The purpose of the IMO model courses is to assist training providers and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training material, so that the quality and effectiveness of the training courses may thereby be improved.

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

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

■ Use of the model course

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

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

Adjustment of the course objectives, scope and content may be necessary if, within the respective maritime industry, the participants completing the course are to undertake duties which differ from the objectives specified in the model course.

Within the Course Outline and Timetable (Part B) the course designers have indicated their assessment of the time that should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and assume that the participants have fully met all entry requirements of the course. The instructor should therefore review these assessments and may need to re-allocate the time required to achieve each specific learning objective.

■ Lesson plans

Having adjusted the course content to suit the participant intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The syllabus contains specific references to textbooks or teaching material suggested for use in the course, where no adjustment has been found necessary in the learning objectives of the syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in presenting the material.

■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied that the participant has attained each specific learning objective or outcome. The syllabus is laid out with a learning objective format, and each objective specifies what the participant must be able to do to achieve the learning objective.

■ Evaluation or assessment of participants' progress

The nature of this course involves all the participants and the instructors in an on-going process of individual and group evaluation. However, as this course doesn't specify any time for evaluation, the process of evaluation or assessment of participants' progress should be confirmed during practical activities related to the subject area concerned. A guideline on evaluation is given in Part E of the course.

■ Implementation

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

- properly qualified instructors;
- support staff;
- rooms and other training locations;
- equipment, e.g. projectors and simulators;
- textbooks, technical papers; and
- other reference material.

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

Part A: Course framework

■ Scope

This model course is designed to facilitate the delivery of training in order to promote the energy-efficient operation of ships. The course contributes to the IMO's environmental protection goals as set out in resolutions A.947(23) and A.998(25) by promulgating industry "Best Practices", which reduce greenhouse gas (GHG) emissions and the negative impact of global shipping on climate change. The course also covers essential subjects to develop management tools to assist a shipping company in managing the environmental performance of its ships. Therefore, the contents of the course reflect the guidance for the development of a Ship Energy Efficiency Management Plan (SEEMP), resolution MEPC.213(63), adopted 2 March 2012.

■ Objective

Having completed the course, the participants should be able to:

- state issues on climate change caused by the effect of greenhouse gas and international measures having been taken since the adoption of the Kyoto Protocol in 1997;
- identify considerations and actions taken by the International Maritime Organization to reduce or limit greenhouse gas emissions from international shipping;
- discuss and apply the details of best practices for fuel-efficient operation of ships;
- establish a ship energy efficiency management plan in a shipping company; and
- maintain the plan in managing the environmental performance of its ships based on the four steps to improve energy efficiency of ships.

■ Entry Standards

Entry to the course is open to those engaged in ship operation both on board and on shore who wish to improve their knowledge and understanding of the energy-efficient operation of ships, especially those who are in charge of activities associated with the development of an SEEMP in shipping companies.

■ Course certificate

Participants completing the course satisfactorily should be issued with a certificate of participation or document describing the objectives of the course and attesting their successful completion of it.

■ Course intake limitations

The course intake is regulated by the number of participants in the class, of which the maximum number of participants should be around twenty. As the course contains some practical activities based on group discussion as well as the use of simulators, the total

number of the participants should also be considered by the number of groups in the class. The minimum number of participants in a group may be three. Otherwise it is difficult to promote active discussion within a group. Other limitation for group sizes might cause from the capacity of simulation facilities.

■ Staff requirements

The instructor shall have appropriate knowledge and skills in instructional techniques for implementing lectures in the classroom as well as practical activities utilizing simulators. The instructor's qualifications should be in accordance with requirements as laid down in section A-I/6 of the STCW Code. It is also recommended that the instructor in charge of the course should either be a holder of a certificate of competency at the management level or have sufficient working experience as personnel in fleet management in a shipping company. All training and instruction should be given by properly qualified personnel. The instructors should have the necessary knowledge, qualification, knowledge and experience in the energy efficient operation of maritime systems.

■ Teaching facilities and equipment

For the theoretical part of the syllabus, a classroom equipped with at least an overhead projector and a flipchart (or equivalent) will be required. A computer driven projector is ideal as this can be used to demonstrate practice and displays of software tools and other relevant technical systems in use onboard or ashore to support energy efficient ship operations to the complete class, utilizing also desktop simulation and interactive CBT-systems

■ Teaching aids(A)

- A1 Instructor manual and its appendix (part D of the course)
- A2 Ship handling simulator
- A3 Engine room simulator
- A4 Video-cassettes or DVDs about systems and procedures demonstrating energy efficient ship operation.

■ IMO references (R)

- R.1 Annex VI of MARPOL consolidated edition 2011, Regulations for the Prevention of Air Pollution from ships and NO_x Technical Code 2008, Technical code on control of emissions of nitrogen oxides from marine diesel engines
- R.2 IMO Policies and Practices related to the Reduction of Greenhouse Gas Emissions from Ships, resolution A.963(23), 4 March 2004
- R.3 Interim Guidelines for Voluntary Ship CO₂ Emissions Indexing for use in Trials, MEPC/Circ.471, 29 July 2005
- R.4 2012 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for no ships, resolution MEPC.212(63), 2 March 2012

- R.5 2012 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI), resolution MEPC.214(63), 2 March 2012
- R.6 2012 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP), resolution MEPC.213(63), 2 March 2012
- R.7 Guidelines for voluntary use of the ship Energy Efficiency Operational Indicator (EEOI), MEPC/Circ.684, 17 August 2009
- R.8 Second IMO GHG study 2009, MEPC 59/INF.10, 9 April 2009

■ Textbooks (T)

No specific text books are recommended for participants' use.

■ Bibliography (B)

- B.1 Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, 1998
- B.2 Donald Wulfinghoff: Energy Efficiency Manual. Energy Institute Press (March 2000)
- B.3 Bellefontaine, N. and Linden, O. (2009). *Impacts of Climate Change on the Maritime Industry*. Proceedings of the Conference on Impacts of Climate Change on the Maritime Industry. Malmö: WMU Publication. (ISBN 978-91-977254-1-5)
- B.4 Faber, J. et al: Technical support for European action to reducing Greenhouse Gas Emissions from international maritime transport. CE Delft Dec. 2009
- B.5 Burnay, S.; McStay, P.: Driving Efficiency within Shipping. MARINE LOG Issue 09/2010
- B.6 INTERTANKO's Guide for a Tanker Energy Efficiency Management Plan (2009)

■ Internet website references (W)

- W.1 A Guide to MARPOL Annex VI
<http://www.martek-marine.com/ProductsSystems/AGuidetotheAmendedMARPOLAnnexVI.aspx>
- W.2 A Guide to Ship CO₂ Indexing
<http://www.martek-marine.com/ProductsSystems/AGuidetoShipCO2Indexing.aspx>

Part B: Course Outline and Timetable

■ Course Outline

Providing that the knowledge, understanding and proficiency contained in part C of this course are fully achieved, the course hours and timetable may be adjusted accordingly based on different standards of prior knowledge in fuel-efficient operation of ships or sea going experience.

	Subject Area	Course hours	Lecture	Practical activity
1.	Background	4.0		
	1.1 Climate Change		2.0	-
	1.2 IMO related work		2.0	-
2.	Guidance on best practices for fuel-efficient operation of ships	18.0		
	Section I: Fuel efficient operations			
	2.1 Improved voyage planning			
	2.2 Weather routing		2.0	2.0
	2.3 Just-in-time			
	2.4 Speed optimization			
	2.5 Optimized shaft power			
	Section II: Optimized ship handling			
	2.6 Optimum trim			
	2.7 Optimum ballast		2.0	2.0
	2.8 Optimum propeller and propeller inflow considerations			
	2.9 Optimum use of rudder and heading control system (autopilots)			
	Section III: Hull and propulsion system			
	2.10 Hull maintenance			
	2.11 Propulsion system		2.0	2.0
	2.12 Propulsion system maintenance			
	2.13 Waste heat recovery			
	Section IV: Management			
	2.14 Improved fleet management			
	2.15 Improved cargo handling		2.0	2.0
	2.16 Energy management			
	2.17 Fuel type			
	2.18 Other measures			
	Section V: Other issues			
	2.19 Compatibility of measures		1.0	1.0
	2.20 Age and operational service life of a ship			
	2.21 Trade and sailing area			
3.	Framework and Structure of the SEEMP	6.0		
	3.1 Planning and goal setting			
	3.2 Ship-specific measures			
	3.3 Company-specific measures		4.0	2.0
	3.4 Human resource development			
	3.5 Self-evaluation and improvement			
4.	Implementation and Monitoring	2.0		
	4.1 Implementation		1.0	1.0
	4.2 Monitoring			
Total Course hours		30.0	18.0	12.0

■ Course Timetable

Period/Day	Day-1	Day-2	Day-3	Day-4	Day-5
1st Period (2 hours)	Introduction to the course 1.1 Climate change Lecture (2 hours)	<i>Section I (2.1 – 2.5)</i> Fuel efficient operations Practical activity (2 hours)	<i>Section III (2.10 – 2.13)</i> Hull and propulsion system Lecture (2 hours)	<i>Section IV (2.14 – 2.18)</i> Management Practical activity (2 hours)	3.4 Human resource development 3.5 Self-evaluation and improvement(2 hours)
Break					
2nd Period (2 hours)	1.2 IMO related work Lecture (2 hours)	<i>Section II (2.6 – 2.9)</i> Optimized ship handling Lecture (2 hours)	<i>Section III (2.10 – 2.13)</i> Hull and propulsion system Practical activity (2 hours)	<i>Section V (2.19 – 2.21)</i> Other issues Lecture (1 hour) Practical activities (1 hour)	Practical activity (2 hours)
Meal Break					
3rd Period (2 hours)	<i>Section I (2.1 – 2.5)</i> Fuel efficient operations Lecture (2 hours)	<i>Section II (2.6 – 2.9)</i> Optimized ship handling Practical activity (2 hours)	<i>Section IV (2.14 – 2.18)</i> Management Lecture (2 hours)	3.1 Planning 3.2 Ship-specific measures 3.3 Company-specific measures Lecture (2 hours)	4.1 Implementation 4.2 Monitoring Lecture (1 hour) Practical activities (1 hour) Conclusion of the course

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

Part C: Detailed teaching Syllabus

■ Introduction

The detailed teaching syllabus has been written in a learning objective format in which the objective describes what the participant must do to demonstrate that knowledge, understanding and proficiency have been transferred.

A learning objective is a statement in specific and measurable terms that describes what the participant will be able to do as an outcome of participating in a series of lectures and practical activities. In this context, all objectives under the subject items shown in the column "Knowledge, understanding and proficiency" of the following table are understood to be prefixed by the words, "The expected learning outcome is that the participant is able to...".

In order to assist the instructors in charge of this course, IMO references, textbooks and bibliography related to each of the subject items are shown in the second and third columns of the table. Suggested teaching aids that assist instructors to implement effective teaching and training are also shown in the fourth column. The following notation and abbreviations are used in the table.

- R IMO reference
- T Textbook
- B Bibliography
- A Teaching Aids

The following abbreviations are also used for identifying where particular references are documented.

- Ap. Appendix
- An. Annex
- Ch. Chapter
- p. Page
- Para. Paragraph
- Sc. Section

The following are examples of the use of references:

R.4 – An. p.151 Ch. 8 Para.8.3 refers to the paragraph 8.3 in Chapter 8 on page 151 of the annex to document MEPC 59/INF.10, 9 April 2009.

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
1.	Background (4 hours)			
1.1	Climate Change .1 apply basic concepts and evaluate the processes influencing the climate. .2 express why climate change occurs. .3 demonstrate how climate change affects the ocean environment and impacts human and maritime activities. .4 analyse how maritime activities influence the climate.		B.1, B.3, B.4	A.1, A.4
1.2	IMO-related work .1 write an overview of work relevant to climate change carried out at IMO. .2 compile the current discussions under MARPOL and Polar Code and how they relate to the problems of climate change. .3 identify and explain a set of IMO's measures to assist the shipping industry to reduce GHG emissions, which are EEDI, EEOI and SEEMP. .4 demonstrate actual calculation of EEDI and EEOI value using existing vessel data.	R.1- R.8	B.4, W.1, W.2	A.1, A.4
2.	Guidance on best practices for fuel-efficient operation of ships (18 hours)			
	Section 1 Fuel efficient operations (Lecture: 2 hours, Practical activity: 2 hours)			
2.1	Improved voyage planning .1 analyse the determination of optimum route and energy efficiency according to the requirements of IMO resolution A.893(21). .2 demonstrate how comprehensive voyage planning and monitoring contribute to energy efficiency. .3 apply passage planning methods specifically addressing and considering the aspects of energy efficiency. .4 Demonstrate how to develop a berth-to-berth passage plan keeping the energy efficiency requirements by using related software and other planning tools.	R.6 Para 5.2-5.3	B.2, B.4, B.5, W.2	A.1-A.4
2.2	Weather routing .1 apply the different methods of weather routing as one essential part of voyage planning and analyse their advantages and disadvantages regarding the energy efficiency indexes and the selection of an energy efficient and most emission-friendly route. .2 get an overview on commercial systems available on the market and state of the art research and technological development. .3 demonstrate how to operate onboard systems and how to work with related shore-based service providers.	R.6 Para 5.4		A.1-A.4

2.3	Just-in-time	R.6 Para 5.5-5.6		A.1-A.4
	.1 identify the principles of "just-in-time" transportation chains and their impact factors. .2 analyse the overall interaction and information flows between the different parties involved in the transport chain. .3 organize how early communication with port authorities and companies could avoid delays and maximize energy efficiency.			
2.4	Speed optimization	R.6 Para 5.7-5.10		A.1-A.4
	.1 identify the fundamental difference between ton-mile and minimum speed and how to interpret the power/consumption curves and ship's propeller curves. .2 evaluate the relations, commons and differences between ship's individual optimum speed and speed optimization of a company's fleet. .3 get an overview on time scheduling methods and the wide range of available methods for speed optimization considering different propulsion systems in terms of different types of fuel, gas or wind and propeller, azimuth and other systems. .4 get a broad overview on concurring target functions for speed optimization and how to work with them.			
2.5	Optimized shaft power	R.6 Para 5.11		A.1-A.4
	.1 identify the use of automated engine management systems to control the revolution and power delivery to the main propeller shaft. .2 discuss the effect of the main engine energy saving governor and its advantage compared with a traditional governor.			
	Section II Optimized ship handling (Lecture: 2 hours, Practical activity: 2 hours)			
2.6	Optimum trim	R.6 Para 5.12		A.1, A2, A.4
	.1 analyse the connection between specified trim conditions of a designed ship and resistance. .2 apply methods to determine the optimum trim with minimum resistance for any given draft. .3 demonstrate how to monitor and assess optimum trim throughout a voyage. .4 analyse and handle safety factors limiting trim optimization.			

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
2.7	Optimum ballast .1 demonstrate how to adjust ballast keeping optimum trim, steering condition and ballast conditions simultaneously. .2 get an overview about the Ballast Water Management Plan and how to consider constraints caused by this plan regarding an optimum ballast. .3 explain the connection between ballast conditions, steering conditions, autopilot settings.	R.6 Para 513 – 5.15		A.1, A.2, A.4
2.8	Optimum propeller and propeller inflow considerations .1 understand that improvements to the water inflow to the propeller using arrangements such as fins and/or nozzles could increase propulsive efficiency power and hence reduce fuel consumption. .2 check the design and operation of the propeller system taking into account: - a delicate balance of efficiency - cavitation performance and pressure pulses - hull excitation and noise - hydrodynamic design of propellers .3 set the simulator system and compare the propeller with and without using arrangements such as fins and/or nozzles to find out how improvements could be made in terms of total thrust.	R.6 Para 5.16 – 5.17		A.1, A.4
2.9	Optimum use of rudder and heading control system (autopilots) .1 understand that optimum use of rudder and heading control systems (autopilots) could achieve significant fuel savings by simply reducing the distance sailed "off track". .2 check the better course control systems that have less frequent and smaller corrections taking into account: - retrofitting of a more efficient autopilot to existing ships - retrofitting of improved rudder blade design .3 consider the proper use of heading control systems with special focus on proper settings in adverse weather conditions and on ballast voyages. .4 set the simulator system and carry out the operation, minimizing losses due to rudder resistance.	R.6 Para 5.18 – 5.20		A.1, A.2, A.4

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
	Section III Hull and propulsion system (Lecture: 2 hours, Practical activity: 2 hours)			
2.10	Hull maintenance .1 state the relationship between effective propulsive power needed for operating a ship and frictional resistance, which is greatly influenced by the surface roughness of the hull under the waterline. .2 identify the effect of the surface roughness of the propeller on reduction of propulsive efficiency. .3 discuss the effect of hull and propeller cleaning on reduction of the fuel consumption. .4 explain types of hull coating paint and discuss the effects on fuel saving.	R.6 Para 5.21-5.24		A.1, A.3, A.4
2.11	Propulsion system .1 identify theoretical background of thermal efficiency of heat engines and discuss the actual parameters to improve thermal efficiency of marine diesel engines. .2 identify heat and mechanical losses generated in the propulsion system on board and explain how to reduce them. .3 evaluate the effect of energy efficient operation of ships based on the fuel consumption of the propulsion system.	R.6 Para 5.25		A.1, A.3, A.4
2.12	Propulsion system maintenance .1 explains the types of damage to the propeller blades and the effect of such damaged surface roughness on propulsion efficiency. .2 states the maintenance requirements based on the SOLAS Convention and the Classification Society requirements. .3 explains that the tail end shaft support system can be equipped with a condition monitoring system to prolong periodic survey/inspection.	R.6 Para 5.26-5.27		A.1, A.4
2.13	Waste heat recovery .1 explain theoretical background of the waste heat recovery system on board based on thermodynamics. .2 identify the mechanism of converting waste heat from exhaust gas of the main diesel engine to both electrical and mechanical power. .3 identify critical issues on the effective operation of the waste heat recovery system and evaluate the effect of the recovery system.	R.6 Para 5.28-5.29		A.1, A.3, A.4

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
	Section IV Management (Lecture: 2 hours, Practical activity: 2 hours)			
2.14	Improved fleet management .1 explain fleet planning principles and methods how to minimize ballast voyages and promote efficiency also for charters. .2 get a broad overview about company-related data-sharing principles with respect to efficiency, reliability and maintenance and how to stimulate better communication between the parties involved.	R.6 Para 5.30-5.31	B.6, W.1, W.2	A.1, A.4
2.15	Improved cargo handling .1 demonstrate how to adjust ballast keeping optimum trim, steering condition and ballast conditions simultaneously. .2 get an overview about the Ballast Water Management Plan and how to consider constraints caused by this plan regarding an optimum ballast. .3 explain the connection between ballast conditions, steering conditions, autopilot settings	R.6 Para 5.32		A.1, A.4
2.16	Energy management .1 implement an effective regime to review electrical services and identify efficiency gains. .2 explain application of thermal insulation to save energy. .3 plan optimization of reefer container stowage taking into account combination with cargo heating and ventilation measures and use of water-cooled reefer plants.	R.6 Para 5.33-5.34		A.1, A.4
2.17	Fuel type .1 identify types of fuel used for maritime transport and their heating values. .2 state that natural gas has low carbon to hydrogen ratio and high power density and produces least CO2 per unit of power. .3 state that the fuel cells convert chemical energy of fuel by oxidation directly into electrical energy and have no emissions and may become future technologies to power ships.	R.6 Para 5.35		A.1, A.4
2.18	Other measures .1 implement and apply appropriate systems to calculate fuel consumption, establish an emissions "footprint", optimize operations, and establish goals for improvement and monitor progress accordingly. .2 evaluate the application of renewable energy sources for on board use and analyse the use of onshore power when in ports. .3 analyse the relation of using fuel of higher quality in regard to minimizing the amount of fuel necessary for the required output.	R.6 Para 5.36-5.40		A.1, A.4

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
	Section V: Other issues (Lecture: 1 hour, Practical activity: 1 hour)			
2.19	Compatibility of measures .1 analyse the SEEMP regarding dependencies for example on areas and trade. .2 identify stakeholders of SEEMP measures and plan and implement agreements between them to provide conditions for most effective utilization of the measures.	R.6 Para 5.41	B.5	A.1, A.4
2.20	Age and operational service life of a ship .1 apply cost-benefit analysis methods to analyse cost effectiveness and feasibility of measures under the aspects of fuel costs and remaining service time of a vessel or fleet.	R.6 Para 5.42		A.1, A.4
2.21	Trade and sailing area .1 evaluate the effectiveness and feasibility of measures for particular ship types with respect to the characteristics of the sailing area. .2 evaluate the effectiveness and feasibility of measures for particular ship types with respect to the characteristics of the trade the ship is engaged in and the length of the ship's specific voyage. .3 produce individual SEEMP according to the analysed conditions.	R.6 Para 5.43-5.44		A.1, A.4
3.	Framework and Structure of the SEEMP			
3.1	Planning and Goal setting .1 identify, apply and implement suitable planning methods and tools for SEEMP. .2 compile ship- and company-specific elements of SEEMP; .3 create and write ship- and company-specific elements of SEEMP.	R.6 Para 4.1.1 and 4.1.7	B.4 - B.6	A.1, A.4
3.2	Ship-specific measures .1 demonstrate suitable procedures to analyse and identify suitable ship-specific measures for energy efficient ship operation. .2 explain elements of the ship's status of energy production and usage and how to determine this status. .3 demonstrate suitable application methods for integration of best practice into a ship-specific SEEMP.	R.6 Para 4.1.2-4.1.4		A.1, A.4

	Knowledge, understanding and proficiency	IMO Reference	Textbooks, Bibliography	Teaching Aids
3.3	Company-specific measures .1 demonstrate suitable procedures to analyse and identify suitable ship-specific measures for energy efficient ship operation. .2 explain elements of the fleet's status of energy production and usage and how to determine this status. .3 demonstrate the application of suitable methods for integration of best practice into a fleet's company-specific SEEMP. .4 demonstrate the development of a communication network between involved stakeholders to coordinate SEEMP measures.	R.6 Para 4.1.5		A.1, A.4
3.4	Human resource development .1 organize the establishment of a sustainable training scheme for on board and onshore personnel. .2 develop and implement procedures for continuous updating of the training scheme.	R.6 Para 4.1.6		A.1, A.4
3.5	Self-evaluation and improvement .1 organize an efficient system to gather meaningful feedback. .2 identify and apply effective methods for self-evaluation. .3 demonstrate the evaluation of ship energy management measures. .4 create efficient procedures and apply suitable tools for improvement of ship energy management.	R.6 Para 4.4.1-4.4.3		A.1, A.4
4.	Implementation and Monitoring			
4.1	Implementation .1 demonstrate the development and maintenance of an SEEMP implementation system. .2 create a sufficient record-keeping system.	R.6 Para 4.2.1-4.2.2	B.4 – B.6	A.1, A.4
4.2	Monitoring .1 compile methods and tools relevant for quantitative monitoring of energy efficiency. .2 demonstrate the calculation of EEOI and other beneficial tools. .3 compile a comprehensive monitoring system including its administrative and technical framework.	R.6 Para 4.3.1-4.3.6		A.1, A.4