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# **Maritime Emission Manager job specification & training programme specifications PART 2**

MARITIME ENGINEER  
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Abstract  The topic of this thesis was to develop GreenShip project's Maritime Emission Manager training programme.  The goal of the GreenShip project is to develop an Emissions Management job specification and a training programme for it specifically for the shipping industry.  In this thesis, quiz questions were created for each chapter and one essay assignment for each main chapter from Emission Manager training material.		
<a href="#">Key words</a> Maritime, Emission Manager		

## GREENSHIP

Currently there is no standard for the proposed role of the Emissions Management role as proposed by the IMO. The goal of the GreenShip project is to develop an Emissions Management job specification and a training programme for it specifically for the shipping industry to be able to continually improve its energy and emissions management on board ships with the view to save energy, reduce pollution and to improve the overall quality of energy and emissions management.

The project will review ship emissions monitoring and management with regards to ship types, ship propulsion systems, ship navigation equipment, energy production units, electrical and mechanical parts and circuitry, safety issues, national certification, accreditation and validation of learning materials, pedagogical aspects of learning and last but by no means least online application.

There are several different parties involved in this project. C4FF has unique knowledge of energy production and engine emissions. The project team has considerable experience of training programme development and their validation and recognition internationally. C4FF are supported by two Maritime Education and Training providers SAMK in Finland and UPC in Spain.

The partnership is complemented by IDEC and CET to make sure the training programme takes all practical aspects into consideration. SPIN in Slovenia has been invited into the partnership to support C4FF in the development of several novel online e-learning platforms. (Koivisto, personal communication on 13.5.2021)

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## LIST OF DEFINITIONS

IMO	International Maritime Organization
C4FF	Centre For Factories Of The Future Limited
UPC	Universitat Politecnica De Catalunya
IDEA	Aintek Symvouloi Epicheiriseon Efarmoges Ypsilis Technologias Ekpaidefsi Anonymi Etaireia
CET	CETENA S.p.A. Centro per gli Studi di Tecnica Navale
SPIN	Spinaker Proizvodnja Trgovina In Trzenje Doo
UNCLOS	United Nations Convention on the Law of the Sea
MARPOL	International Convention for the Prevention of Pollution from Ships

## 1 INTRODUCTION

The topic of this thesis was to develop a GreenShip training program. In this thesis, quiz questions were created for each chapter and one essay assignment for each main chapter.

The purpose of the quiz questions was to create quick repetitive tasks, which will enable the person attending the training program to quickly go through what they have just learned. The purpose of the essay assignment is to create slightly more challenging tasks, for which the person attending the training program has to apply what they have learned. A total of ten Quiz questions were created for each chapter. This thesis presents the questions made in this thesis. In Quiz questions the correct answer is underlined.

## 2 CHAPTER 1 ENVIROMENTAL CONCERNS AND IMO RE- SPONSE

Chapter 1 reviews environmental concerns and the IMO response to them. In order to manage international shipping, there are several international rules. Chapter 1 examines the regulatory framework developed by the IMO on the environmental impact of shipping and the subsequent climate change to address this issue. There are two organizations working together to develop regulatory frameworks. They are IMO and UNCLOS. These organizations are bound by the provisions of international maritime and maritime law. UNCLOS has numerous references to environmental protection. (Mariems, 2017)

### 2.1 Essay of environmental concerns related to shipping and IMO's response towards it.

#### Introduction:

Global warming and environmental concerns are important themes in today's maritime industry.

#### Aim:

To understand environmental concerns related to shipping and IMO's response to it.

#### Learning Outcomes:

At the end of assignment you will;

Be familiar with IMO's actions towards global warming,

Understand the importance of environmental concerns related to shipping

#### Assignment Brief:

Write short essay about environmental concerns related to shipping and IMO's response towards it.

Answer:

Essay should contain at least;

Mention of shipping's comparison to other transport modes.

Mention of the growth of transportation by ships

Explanation of MARPOL and UNCLOS

MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

UNCLOS is United Nations Convention on the Law of Sea. A complete part of the material is dedicated to the protection of the environment. Part XII reflects the main objectives of the UN in terms of environmental protection which occurred in parallel to the extensive negotiations to develop the UNCLOS



### 3 CHAPTER 2 FUEL MANAGEMENT

Chapter 2 reviews fuel management. Currently, heavy fuel oil, HFO, is the most widely used fuel in international shipping. HFO accounts for about 77% of all marine fuels. HFO is relatively inexpensive, it has a high carbon content and a very high energy density. HFO is also a residue from the refining industry. However, recent global environmental issues have shown the need for alternative fuels in the maritime sector.

To this end, all stakeholders have begun to look for alternative technologies and alternative fuels to reduce the environmental footprint of ships. The main alternative fuels currently available for shipping are mainly hydrogen, power for liquid fuels, various biofuels and LNG. (Mariems, 2017)

#### 3.1 Quiz

1 Fuel storage on board must be treated..

- a) before use
- b) during the use
- c) after the use
- d) it isn't necessary

2 Most used fuel in international shipping is..

- a) MDO.
- b) LNG.
- c) HFO.
- d) Methanol.

3 Amount of NO<sub>x</sub> produced is higher when...

- a) the combustion temperature is higher and when the cooling of the gases produced is slower.
- b) the combustion temperature is higher and when the cooling of the gases produced is faster.
- c) the combustion temperature is lower and when the cooling of the gases produced is faster.

- d) the combustion temperature is lower and when the cooling of the gases produced is slower.

4 The parameter that influence the formation of NO<sub>x</sub> is..

- a) the mixing degree between fuel and air
- b) the combustion temperature
- c) the permanence of the fuel in the cylinder
- d) all above

5 SO<sub>x</sub> is mainly formed by the lubricant absorption. True/False

6 Which of these are not part of Particulate Matter?

- a) Soluble Organic Fraction
- b) Particulate matter from sulphates
- c) Hydrocarbons and volatile organic compounds
- d) Solid Fraction

7 The air temperature increasing decreases the soot of emissions. True/False

8. Sulphur can cause acid rain after combustion. True/False

9 Alternative fuels in shipping sector are needed for..

- a) lower costs.
- b) in order to decrease the environmental footprint of ships.
- c) easier storage.
- d) higher carbon content

10 Hydrogen's emission is..

- a) NO<sub>x</sub>
- b) PM
- c) H<sub>2</sub>O
- d) CO<sub>2</sub>

3.2 Essay of alternative fuels for maritime applications.

Introduction:

Maritime industry is forced to change using heavy fuel oil to alternative fuels. To understand the future of energy production in maritime industry one is needed to be familiar with the fuels that will be most likely to be used in future.

Aim:

To understand environmental concerns related to shipping and IMO's response to it. Towards this exchange is related many issues that needs to be solved.

Learning Outcomes:

At the end of assignment you will;

Be familiar with most promising alternative fuels for maritime applications,

Understand their integrating issues, availabilities, and emissions.

Assignment Brief:

Write short essay about the most promising alternative fuels for maritime applications

Answer:

Essay should contain at least;

Names of all promising alternative fuels (natural gas, methanol, ammonia, hydrogen)

Their availability:

Natural gas - ashore, developing in ports

Methanol - ashore, obtained from fossil fuels or from renewables

Hydrogen - sporadically ashore, obtained from fossil fuels or from renewables (electrolysis)

Ammonia - sporadically ashore, obtained from fossil fuels or from renewables (electrolysis)

Their emissions:

Natural gas - NO<sub>x</sub>, PM, CO<sub>2</sub>, CH<sub>4</sub> (slip)

Methanol - NO<sub>x</sub>, PM, CO<sub>2</sub>

Hydrogen - H<sub>2</sub>O

Ammonia – NO<sub>x</sub>

Their integrating issues:

Natural gas - Combined with dual fuel engine, Cryogenic liquid storing or compressed.

Methanol - Stored in liquid form (at ambient temperature), to be used with dual fuel engine, gas turbines or fuel cells (under development)

Hydrogen - Difficult to be stored (low volumetric density). To be used coupled with fuel cells or internal combustion engines (under study) or gas turbines (under study).

Ammonia – Can be stored as liquid at moderate pressures (10-15 bar) or refrigerated at -33 °C. To be used with internal combustion engines (under study) or with fuel cells.

## 4 CHAPTER 3: SHIP MAINTENANCE AND ENERGY EFFICIENCY

Chapter 3 review ship maintenance and the impact of maintenance on ship energy efficiency. Examples of rules and regulations affecting the maritime sector are the International Safety Management (ISM) Code, the International Convention for the Certification and Watchkeeping of Seafarers (STCW), the International Ship and Port Facility Security Code (ISPS) and the International Convention for the Prevention of Pollution from Ships (MAR). The ISM Code for ship maintenance and equipment generally describes how ships should be maintained, inspected, non-conformities be reported and corrective action taken. The ship's planned maintenance scheme is a statutory requirement of the ISM Code. Poor maintenance can mean that either a ship is unable to meet its commercial obligations or can cause potential safety or environmental damage. (Mariems, 2017)

### 4.1 Essay of maintenances effects on ships energy efficiency

Introduction:

Maintenance has great effect on ships energy efficiency.

Aim:

To understand maintenances effects on ships energy efficiency.

Learning Outcomes:

At the end of assignment you will;

Be familiar with how maintenance has effect on ships energy efficiency,

Understand the importance and challenges involved with maintenance.

Assignment Brief:

Write short essay how maintenances effects ships energy efficiency.

Answer:

Essay should contain at least;

Mention that poor maintenance can mean that either the ship cannot meet its commercial obligations or can pose a potential safety or environmental hazard. Mention that equipment downtime cause delays and de-efficiency.

Mention that hull and propeller condition have great impact on fuel consumption. Hull and propeller should be kept clean.

Mention that any shaft, belt, chain and coupling misalignments can cause major energy losses and machinery breakdowns.

Mention that bad lubrication can cause energy losses and bearing breaks.

Mention that compressed air system can have air leaks, excessive end-use air consumption and air compressor conditions.

## 5 CHAPTER 4.1 BOILERS AND STEAM SYSTEM

Chapter 4.1 review the use of steam on ships. Steam plays a very important role on ships. Steam is most commonly used to heat fuel, ships and cargo, as well as to generate electricity. It can also be used for propulsion in suitable ships. The efficient use of steam is important for the operation of the entire ship. (Mariems, 2017)

### 5.1 Quiz

1 For the best efficiency if there are two auxiliary boilers on ship, they should always be run parallel to divided the load. True/False

2 Excess air unused in the combustion can cause energy loss. True/False

3 Soot blowing an exhaust gas economiser once or twice a day while at sea can improve its efficiency. True/False

4 Steam leaks should be check once a week. True/False

5 Boilers consumption is about 6% of the total world fleet fuel consumption. True/False

### 5.2 Essay of steam systems energy efficiency

Introduction:

By optimising the energy efficiency of steams systems significant amounts of unnecessary energy consumption can be prevented.

Aim:

To understand the basics of steam systems energy efficiency and the effects it has on fuel consumption.

Learning Outcomes:

At the end of assignment you will;

Be familiar with steam systems energy efficiency,

Understand the effects proper management has on fuel consumption.

Assignment Brief:

Write short essay about steam systems energy efficiency.

Answer:

Essay should contain at least;

Mention that maximum efficiency of boiler is when it is working in workload of 80%

Mention of use of multiple boilers and that if there are more than one boiler only one should run if workload demand is low.

Excessive combustion air and that it should be minimized.

Mention of exhaust gas economisers and that they should be used when available and auxiliary boilers should be use only when necessary.

Mention that steam losses through open bypass valves, steam losses through failed open steam traps and heat losses through un-insulated or improperly insulated piping and equipment should be avoided.

Mention that insulation should be kept in good condition.

Mention that steam system should be checked regularly for leaks and breakage.

Mention that cargo tank heating shall be set as low as cargo specification allows.

Mention that bunker heating should be optimized.



## 6 CHAPTER 4.2 TRIM, HULL AND PROPELLER DESIGN AND OPTIMISATION

Chapter 4.2 review the design and optimization of the trim, hull and propeller. In the past, trimming has focused on achieving the best seaworthiness. Today, the most important criteria are energy efficiency and reducing emissions. If both criteria are met, the trim is excellent. The trim is normally defined as the difference between the stern and forward drafts. Optimum trim is trim where required propulsive power is minimal. Optimum trim is achieved with proper design and the ship's ballast plan. The ship's resistance and trim are closely related. Trim affects the wetted surface area of the hull and thus increases or decreases the decelerating forces on the ship. The hull and propellers suffer from degraded performance due to surface roughness. Surface roughness is mechanically caused by human errors or mechanical defects, such as mechanical damage, failure of the applied coating, and even improper surface preparation and / or improper application of a new coating. Biological roughness (fouling) occurs when some organic growth adheres to the hull. (Mariems, 2017)

### 6.1 Quiz

1 What can cause affect to ship's propulsion fuel consumption?

- a) Organic growth sticks on the hull
- b) Physical surface roughness on propeller
- c) Failure of the applied coating
- d) All above

2 Clean hull and proper working coating can save 10-12% on fuel consumption.

True/False

3 In order to minimize a ship's frictional resistance both physical and biological roughness must be address. True/False

4 What can influence hull fouling rates?

- a) Temperature of water
- b) Hull maintenance
- c) Ship speed
- d) All above

5 Real-time bunker and water transfer on-board can effect on ship's trim if the officers in the watch might have incomplete knowledge of the bunker and water transfers on-board. Ture/False

6 Dynamic trim refers..

- a) to zero trim.
- b) to when the ship is in still water.
- c) to when ship is underway and moving.
- d) to when aft and fore is the same.

7 Fouling is problem on propellers that are constantly moving. True/False

8 Good communication between port and ship is important while loading a ship to ensure good wight distribution in order to allow optimum trim. True/False

## 7 CHAPTER 4.3 TECHNICAL UPGRADE AND RETROFIT

Chapter 4.3 review upgrading ship's technical equipment. One effective way to improve a ship's energy efficiency is to upgrade technologies already on board to be more energy efficient. It is very dependent on the vessel how the technologies can be updated, but in many cases it is a very profitable option. (Mariems, 2017)

### 7.1 Quiz

1 Up to 1 % of fuel used on board may end up in sludge. True/False

## 8 CHAPTER 4.4 CARGO AND BALLAST MANAGEMENT

Chapter 4.4 review issues relating to ship loading, use of ballast water, use of loading or unloading equipment and their impacts on ship energy efficiency. (Mariems, 2017)

### 8.1 Quiz

1 How ship's size affects its energy efficiency?

- a) Small ship has better efficiency.
- b) Larger ship has better efficiency.
- c) Ship size has no affect.

2 International Load line..

- a) is placed mid-way between the forward and after perpendiculars of the ship.
- b) takes water temperature and density to account.
- c) gives the legal limit to ships draft to which ship may be loaded.
- d) All above

3 GHG reducing equipment may affect ships port dues. True/False

4 Ship's energy efficient decreases when it is using more of its capacity. True/False

5 Small ships are needed because large ships are limited to a few deep-water hub ports.  
True/False

6 Fewer large ballast tanks are more ideal for improving stability and changing trim than many smaller tanks. True/False

## 9 CHAPTER 4.5: SHIPBOARD OPERATIONS AND ENERGY EFFICIENCY AND REFERENCES TO CREW RESPONSIBILITIES

Chapter 4.5 review fleet management issues and ways to implement best practices for implementing a sustainable fleet in terms of environmental protection and cost reduction. (Mariems, 2017)

### 9.1 Quiz

1 Emissions in port areas are mainly those due to..

- a) boilers.
- b) diesel engines.
- c) both a and b

2 Emission reduction in the port areas are typically focussed on..

- a) GHGs impacts.
- b) CO<sub>2</sub> impacts.
- c) air quality health impacts

3 Around 85% of emission come from..

- a) passenger ships.
- b) containerships and tankers.
- c) Ro-Ro vessels.

4 Most contaminant ship type is..

- a) tanker.
- b) containership.
- c) Ro-Ro vessel.
- d) cruise ship.

5 There has been shift from industrial to tramp shipping during the last decades.

True/False

6 Ships speed..

- a) should be select to ensure proper steerage and safe operation.
- b) should be chosen so that the ship doesn't enter port when it is closed.
- c) has significant impact on fuel consumption. By reducing the speed 20% reduces the fuel consumption by about 36%.
- d) All above

7 Who could have the highest influence for an energy efficient ship operation on board?

- a) Chief Engineer
- b) Chief Officer
- c) Master
- d) First Engineer

8 Autopilot can achieve significant fuel saving. True/False

9 Marine diesel engines have a low thermal efficiency. True/False

10 Ships maintenance..

- a) has significant impact on ships efficiency.
- b) can be challenging through crew shrinking size.
- c) increasingly relies on third parties.
- d) All above

## 10 CHAPTER 5: E-NAVIGATION AND WEATHER ROUTING

Chapter 5 review E-Navigation and weather routing. Modern, proven tools can increase the reliability of shipping and communications and thus reduce errors. Navigation errors and defects have been significant in events requiring overall investigation. The IMO considers the implementation of e-navigation in the world fleet to be a long-term goal. Electronic navigation also implements many other elements of ship and shore management than mere navigation with the aim of ensuring the highest level of environmental protection and safety. The system can combine measures such as transit planning with dynamic real-time tracking to ensure that pre-planned clearance under the keel is maintained throughout the trip. The route of ships can also be analysed in real time in relation to GHG emissions to look for ways to reduce fuel consumption, emission reductions and costs. (Mariems, 2017)

### 10.1 Essay of ECDIS

#### Introduction:

ECDIS has many advantages related to energy efficiency.

#### Aim:

To understand the basics ECDIS's advantages and applications related to energy efficiency.

#### Learning Outcomes:

At the end of assignment you will;

Be familiar with ECDIS,

Understand the advantages and applications ECDIS has related to energy efficiency and fuel consumption.

#### Assignment Brief:

Write short essay about ECDIS and its advantages.

Answer:

Essay should contain at least;

Mention of its availability to show useful information (speed, water depth, position, estimated time of arrival)

Mention of its availability to include the ships passage plan and ability to analyse it and calculate the optimum speed.

Mention of its availability to monitor ships position and ensure ship follows optimum course and therefore minimize fuel consumption.

Mention of its potential to improve the fuel efficiency of vessel by following a Great Circle curve track and therefore ship can travel shortest route possible.



## 11 CHAPTER 6 PORT OPERATIONS, AIR EMISSIONS AND EFFICIENCY

Chapter 6 review technical solutions for reducing emissions in the port area. International shipping is the most energy-efficient mode of cargo transport in world trade, but unfortunately it is also a major producer of NO<sub>x</sub>, SO<sub>x</sub> and CO<sub>2</sub> emissions. There is no comprehensive research data of the effects of port operations on the ship's energy efficiency. The reason for this is probably that the regulation of ports is mainly national and not international. Despite this lack of regulation, seaports are important for the energy efficiency of shipping and, in particular, play an important role in the operation of energy-efficient ships. (Mariems, 2017)

### 11.1 Essay of ships operational energy efficiency measures in port.

#### Introduction:

Ships are main air polluters in ports. With the right measures, pollution can be reduced.

#### Aim:

To understand the basics of ships operational energy efficiency measures in port.

#### Learning Outcomes:

At the end of assignment you will;

Understand the basics of ships operational energy efficiency measures in port.

Understand the importance of energy efficiency measures in port.

#### Assignment Brief:

Write short essay about ships operational energy efficiency measures in port.

#### Answer:

Essay should contain at least;

Mention that the time ship spend in port should be minimized.

Mention that energy efficiency actions are depending of crew's actions.

Mention that in all machinery sea-going condition should be change to port condition.

Mention that the number of unnecessary parallel machinery should be minimized.

Mention that the number of A/C units in operation should be minimixed.

Mention that the number of engine ventilation fans should be reduced or brought to slower speed.

Mention that unnecessary lighting should be switched off.

Mention that boiler systems should be optimized by using avoiding use of multiple boilers if possible.

## 12 CONCLUSION

Emission management is and will be important part in shipping. As climate change progresses, we must also look for new ways to limit emissions from maritime transport. Maritime transport is the world's largest form of freight transport and is therefore very important in limiting emissions. The crew has the opportunity to influence the ship's energy efficiency and emissions. The efficient and optimal use of the equipment requires professionalism and interest in the matter. Raising awareness is an important part of making change.

Creating good tasks was much harder than I could have expected. A good task should be challenging enough. Not too easy, but also not too hard. A good task focuses on important topics and doesn't pay too much attention to detail. A good task should also be meaningful to do to keep motivation.

## REFERENCES

Koivisto, H. 2021. Project Manager, Satakunta University of Applied Sciences. Rauma. Personal communication

Mariems. 2017. SEMT: Air emission a Local and Global Concern. Referred 23.5.2021.

<http://mariems.com/moodle/mod/page/view.php?id=11>

Mariems. 2017. SEMT: Fuel management. Referred 30.04.2021.

<http://mariems.com/moodle/course/view.php?id=2&section=6>

Mariems. 2017. SEMT: Energy Efficiency Management and Operational Measures.

Referred 4.5.2021 <http://mariems.com/moodle/course/view.php?id=2&section=14>

Mariems 2017. SEMT: Engines and Machinery Load and Utilisation Management.

Referred 7.5.2021. <http://mariems.com/moodle/course/view.php?id=2&section=5>

Mariems 2017. SEMT: Boilers and Steam System. Referred 7.5.2021.

<http://mariems.com/moodle/course/view.php?id=2&section=8>

Mariems 2017. SEMT: Trim, Hull and Propeller Design and Optimisation. Referred

8.5.2021. <http://mariems.com/moodle/course/view.php?id=2&section=3>

Mariems 2017. SEMT: Technical upgrade and Retrofit. Referred 10.05.2021.

<http://mariems.com/moodle/course/view.php?id=2&section=7>

Mariems 2017. SEMT: Cargo and Ballast Management. Referred 10.05.2021.

<http://mariems.com/moodle/course/view.php?id=2&section=10>

Mariems 2017. SEMT: Ship-Board Operations and Energy Efficiency and references to Crew Responsibilities. Referred 12.05.2021.

<http://mariems.com/moodle/course/view.php?id=2&section=2>

Mariems 2017. SEMT: E-Navigation and weather routing. Referred 14.05.2021.  
<http://mariems.com/moodle/course/view.php?id=2&section=4>

Mariems 2017. SEMT: Port operations, Air emissions and Efficiency measures. Referred 19.5.2021. <http://mariems.com/moodle/course/view.php?id=2&section=9>