IAMU 2012 Research Project
(No. 2012-3)

IAMU Model Course for Electro-Technical Officers (ETO)

By

Odessa National Maritime Academy (ONMA)

September 2013

IAMU
International Association of Maritime Universities

International Association of Maritime Universities

This report is published as part of the 2012 Research Project in the 2012 Capacity Building Project (supported by The Nippon Foundation) of International Association of Maritime Universities (IAMU).

Published by the International Association of Maritime Universities (IAMU) Secretary's Office
Toranomon 35 Mori Building 7F, 3-4-10 Toranomon, Minato-ku,
Tokyo 105-0001, JAPAN
TEL : 81-3-5408-9012 E-mail : info@iamu-edu.org URL : http://www.iamu-edu.org

ISBN978-4-907408-00-8

THE NIPPON FOUNDATION

IAMU 2012 Research Project

(No. 2012-3)

IAMU Model Course for Electro-Technical Officers (ETO)

By

Odessa National Maritime Academy (ONMA)

Contractor : Mykhaylo V. Miyusov, Rector, ONMA

Research Coordinator : Vadym M. Zakharchenko, Vice-Rector, ONMA

Research Partners : Janusz Mindykowski, Vice-Rector, GMU

Ruan Wei, Director, Shanghai Seafarers Training Centre, SMU

Contents

1. Introduction 2
2. Research Objectives 3
3. Research Activities and Proceedings 3
4. Research Results 6
5. References 7

Appendix A. The first project meeting details 9
.1 Agenda for the first project meeting 9
.2 Minutes of the first project meeting 9
Appendix B. The second project meeting details 11
.1 Agenda for the second project meeting 11
.2 Minutes of the second project meeting 11
Appendix C. The third project meeting details 13
.1 Agenda for the third project meeting 13
.2 Minutes of the third project meeting 13
Appendix D. Research questionnaires 15
.1 The first stage of research 15
.2 The second stage of research 15
.3 The third stage of research 16
Appendix E. Presentation for IAMU AGA13 17
Appendix F. Model Course for Electro-Technical officers 34

IAMU Model Course for Electro-Technical Officers (ETO)

Vadym Zakharchenko
Professor Dr., Vice-Rector, Odessa National Maritime Academy, zvn@onma.edu.ua

Janusz Mindykowski
Professor Dr., Vice-Rector, Gdynia Maritime University, janmind@am.gdynia.pl

Ruan Wei
Director, Shanghai Seafarers Training Center, Shanghai Maritime University, weiruan-smu@163.com

Abstract: *The standards of training and certification regarding electro-technical officer (ETO) established in a new edition of the STCW Convention and STCW Code are the first international standards for electro-technical personnel in the history. Development of study programmes for ETOs currently is one of the most important tasks for maritime education and training institutions. Standards established in a new edition of the STCW Convention and STCW Code regarding ETO should be accepted as minimum standards only. Analysis of modern and nearest future needs shows that minimum two levels of qualifications (ranks) for ETOs are required.*
The first level of ETO qualification should correspond to the standards of competence for ETO at the operational level as presented in the STCW Code. The second level of ETO qualification should correspond to advanced knowledge, understanding and proficiency in field of marine electrical engineering and ability to manage electro-technical personnel.
Research partners propose a complex model course for ETO with a view of two levels of ETO qualifications. This model course includes Course for ETO and Course for Senior ETO as well as recommended Training Record Book.
General description of qualifications and entry requirements, specifications of competences and related learning outcomes, demonstration methods and recommendations for assessment, recommended list of subjects and subject descriptors, course timetables and recommended equipment and teaching facilities are presented in Course for ETO and Course for Senior ETO.
Training Record Book includes necessary specifications and templates for workshop and onboard training records.

Keywords: *Model Course, Qualification, Competence, Learning outcomes, Workload, Training.*

1. Introduction

The Manila amendments to the Annex to the International Convention on Standard of Training, Certification and Watchkeeping for Seafarers (STCW Convention) and to the Seafarers' Training, Certification and Watchkeeping Code (STCW Code) were entered into force on the 1st of January, 2012. The new edition of the STCW Convention and STCW Code includes standards regarding electro-technical officers (Regulation III/6 of the STCW Convention and Sections A-III/6 and B-III/6 of the STCW Code) [1]. The standards regarding electro-technical officers are the ones of the most important amendments to the STCW Convention and Code that were adopted in 2010.

These standards are the first in history international standards for electro-technical personnel. Before the adoption of the above mentioned standards the unified requirements to the competencies and the level of responsibility of electro-technical personnel were not established. Different countries and different maritime education/training institutions trained ship electro-technical specialists in accordance with their national and/or institution requirements.

Due to the need of development and implementation new study programmes for ETO not later than on 1st of July, 2013, Model Course for electro-technical officer (ETO) is one of the most expected courses for maritime education/training institutions.

In May, 2013 the 44th session of Sub-Committee on Standards of Training and Watchkeeping of IMO (STW Sub-Committee) approved IMO Model Course for ETO based on the standards established in Section A-III/6 of a new edition of the STCW Code. Publication of this Model Course is expected nearest time.

At the same time standards regarding ETO that were established in the new edition of the STCW Convention and STCW Code should be accepted as minimum standards only. These standards do not cover a wide range of competencies that are necessary in modern marine engineering.

Specification of minimum standards of competence for ETO, that presented in the Table A-III/6 of the STCW Code does not contain the higher competence requirements regarding systematic diagnosis, analysis and handling of the electronic equipment, does not take into account the growth of navigational technologies and electronics, and smart (intelligent) systems in full.

Besides on some vessel types electro-technical competences are provided by electro-technical groups that might include few electro-technical officers. Management tasks relating to electro-technical personnel appear in such situations. Analysis of modern and nearest future needs shows that minimum two levels of responsibilities and two levels of qualifications for ETOs are required. At the same time having been approved in 2010, Manila amendments do not require training to the management tasks for ETO. These tasks also are not reflected in the expected IMO Model Course for ETO.

On the other hand, during the process of comprehensive review of the STCW Convention and STCW Code delegations from a large number of countries have been successively supporting the idea of two-level standards for ETO including standards for Senior electro-technical officer (Senior ETO) at the management level. This idea was widely discussed and reflected in documents of STW Sub-Committee [2] as well as in proposals to the Manila Conference [3].

In this context, the Committee of the Whole of the STCW Conference in Manila invited the Maritime Safety Committee (MSC) to consider the proposal of Senior ETO with a view to establishing a new work programme item for the STW Sub-Committee [4]. At the same time MSC invited Member Governments and international organizations to submit proposals relating Senior ETO [5], [6].

Taking into account all the above research partners propose Model Course for electro-technical officers with a view of two levels of ETO's qualifications (ranks). Two-level based approach is the main feature of the Model Course for electro-technical officers that was developed during research. The actually proposed Model Course is a complex Model Course that includes two parts – Course for ETO and Course for Senior ETO. The other important feature of the proposed Model Course is inclusion of additional competences for ETO at the operation level, that are not presented in the Table A-III/6 of the STCW Code as well as in expected IMO Model Course for ETO. These competences were defined during research.

In context of implementation of new study (training) programmes for electro-technical officers one more expectation is recommended Training Record Book. The research partners propose recommended Training Record Book which supports Course for ETO and leads to Certificate of competency as a part of the complex Model Course.

2. Research Objectives

The main objective of the project is the Model Course for electro-technical officers which is based on two levels of ETO qualifications. This Model Course should assist maritime universities and other maritime training institutions in designing study/training programmes leading to qualifications of electro-technical officers.

According to the established main objective and to the project background the specific objectives of the project are following:

- Course for electro-technical officer that should ensure professional-oriented learning outcomes to support the ETO competencies at the operational level;
- Course for Senior electro-technical officer that should ensure professional-oriented learning outcomes to support the competencies related to operating and maintaining specific ship's electrical and electronics equipment, complex systems; management of ship's electro-technical personnel and resources; management of complex activities related to electrical and electronics equipment;
- Training Record Book supporting the Course for electro-technical officer and required by the Regulation III/6 of the STCW Convention.

3. Research Activities and Proceedings

The idea of project has been developed on the base of the research partners coordinated work at number of sessions and intersessional meetings of STW Sub-Committee of IMO during the comprehensive review of the STCW Convention and STCW Code.
Implementation of established in a new edition of the STCW Convention and STCW Code standards regarding ETO as well as proposals regarding two levels of ETO qualifications were consistently considered in partner maritime higher educational institutions and reflected in few papers of research coordinator [7], [8].

Research work consisted of the following work packages (WP):

WP1 – defining of a Model Course concept, a general framework and a structure;
WP2 – elaboration of a Course for ETO;
WP3 – elaboration of a Course for Senior ETO;
WP4 – elaboration of a Training Record Book;
WP5 – general overview and preparation of a project final report.

Research time was divided into three main stages. Key point for each stage was appropriate project meeting. During each stage the tasks of different work packages were carried out taking into account collected information, received proposals, feedbacks and outcomes of research events. Research work was carried out from WP1 to WP5 with reviews and improvements. For each stage of research an appropriate research questionnaire was developed with a view of the following main tasks:

1st stage – defining of the Model Course general framework and elaboration of the Course for ETO;
2nd stage – improvement of the Course for ETO and elaboration of the Course for Senior ETO;
3rd stage – improvement of the Course for Senior ETO, elaboration the Recommended Training Record Book and preparation of the project final report.

Research activities have included development of the research questionnaire, collection of information and development of appropriate proposals in partner universities, presentation of the project interim report at IAMU AGA-13, discussion of research questions and consideration of proposals as well as making joint decisions at three project meetings and correspondent work.

The first project meeting

The first project meeting was held in Odessa National Maritime Academy from the 5th to the 7th of July, 2012. Representatives of Odessa National Maritime Academy, Gdynia Maritime University and Shanghai Maritime University took part in this meeting.
The following main questions were discussed at the first project meeting: concept of ETO carrier development and concept of IAMU Model Course; general descriptions of ETO's qualifications; relation between Model Course and higher education programmes; Model Course structure and improving of specification of competencies for ETO at the operational level that is presented in STCW Code.
During discussions, the following aspects were taken into account by the project partners: traditions and experience in ETO training and certification in different countries, experience of partner maritime higher education institutions, outcomes of Manila Conference, 2010 and decisions of Maritime Safety Committee [5], [6], information and experience of shipping companies and marine electro-engineers.
The main outcomes of the first project meeting were following:

- The partners agreed that two levels of ETO qualifications should be reflected in IAMU Model course for ETOs;
- The structure of the IAMU Model course for ETOs was agreed by the partners;
- The relations between the Model course for ETOs and International Standard Classification of Education were defined;
- The structure of qualification descriptors was defined;
- The amendments to the specification of competencies for ETO at the operational level were defined and approved by the partners.

The partners also defined further tasks and joint work schedule for the next stage of research.
The Agenda and the Minutes of the first project meeting are presented in the Appendix A.

Participation at IAMU AGA 13, 15-17 October, 2012

During the AGA 13 in Fisheries and Maritime Institute of Memorial University of Newfoundland, St. Johnes, Canada the Project Coordinator Professor Dr. Vadym Zakharchenko made Presentation on the Project`s Interim Report titled on "IAMU Model Course for Electro-Technical Officers (ETO)".
Printed presentation is attached in the Appendix E.

The second project meeting

The second project meeting was held in Odessa National Maritime Academy from the 22nd to the 23rd of November, 2012. Representatives of two partner higher education institutions took part in this meeting: Odessa National Maritime Academy and Gdynia Maritime University as well as invited representative of Kerch State Maritime Technological University.
The following main questions were discussed at the second project meeting: project interim report and outcomes of AGA-13; Course framework structure; general descriptions both for ETO and Senior ETO qualifications; generic competencies both for ETO and Senior ETO qualifications; specification of expected learning outcomes and recommended list of subjects for the Course for ETO; structure and content of description of subjects for the Course for ETO; proposals on specifications of professional competencies and related expected learning outcomes for Senior ETO qualification; development of description of subjects for the Course for Senior ETO; concept and proposals on methods for

demonstration and assessment of learning outcomes; development of specifications of teaching equipment and facilities.
The main outcomes of the second project meeting were following:

- A structure of Course framework for both courses was defined and approved by the partners;
- Specifications of generic competencies for ETO and Senior ETO qualifications were defined and approved by partners;
- Amendments to specification of ETO competencies at the operational level and a list of subjects for the Course for ETO were approved by the partners finally;
- Recommended list of subjects for the Course for ETO was approved by partners;
- Structure of description of subjects was agreed by partners;
- The partners agreed to develop a recommended Training Record Book and to include it to the Model Course as annex with a view of supporting workshop and onboard training in accordance to the Regulation III/6 of the STCW Convention;
- The partners agreed the concept of methods for demonstration and assessment of learning outcomes;
- The partners agreed to develop proposals on specifications of professional competencies and related expected learning outcomes for Senior ETO qualification and specification of teaching equipment and facilities at the next stage of research and approved further tasks and joint work schedule.

The Agenda and the Minutes of the second project meeting are presented in the Appendix B.

During the period of time between the second and the third project meetings the partners have developed the following proposals:

- Draft specification of professional competencies for Senior ETO;
- Draft specification of expected learning outcomes for the Course for Senior ETO;
- Draft specification of methods for demonstration of learning outcomes and recommendations for assessment;
- Draft lists and descriptions of subjects for the Course for Senior ETO;
- Draft Training Record Book;
- Draft specification of teaching equipment and facilities.

General descriptions of qualifications and draft specification of professional competencies for Senior ETO were developed with taking into account the ideas stated in papers [7], [8] and recommendations that were received at the AGA-13.

According to the recommendations of the AGA-13 experienced marine electro-engineers as well as engineers and chief engineers were involved in reviewing proposals and the whole Model Course.

The third project meeting

The third project meeting was held in Odessa National Maritime Academy from the 11th to the 12th of April, 2013. The representatives of two partner higher education institutions: Odessa National Maritime Academy and Gdynia Maritime University took part in this meeting.

The following main questions were discussed at the third project meeting: proposed specifications of competencies and linked expected learning outcomes for the Course for Senior ETO; a proposed list and description of subjects for the Course for Senior ETO; student's (trainee's) workload; proposed structure and content of the recommended Training Record Book; proposed specification of teaching equipment and facilities.
The main outcomes of the third project meeting were following:

- Specifications of competencies and expected learning outcomes for the Course for Senior ETO were approved by partners;
- Recommended lists and description of subjects for the Course for Senior ETO were approved by the partners;
- Recommended student's workload both for the Course for ETO and the Course for Senior ETO was defined;
- The structure, content and necessary templates of the recommended Training Record Book were agreed and approved by the partners;
- The structure of the project final report was agreed;
- The partners approved tasks and joint work schedule for the final stage of research project.

The Agenda and the Minutes of the third project meeting are presented in the Appendix C.

The final version of IAMU Model Course and final report preparation questions were discussed at non-formal meeting during the 44th session of the STW Sub-Committee which was held from the 29th of April to the 3rd of May, 2013 at IMO Headquarters.
Prof. Dr. Vadym M. Zakharchenko, ONMA (research coordinator), Prof. Dr. Janusz Mindykowski, GMU, Mr. Ruan Wei, SMU (research partners) and Mr. Jacek Wyszkowski, GMU took part in this discussion.

Developed Model Course was presented and discussed at the session of Methodological Commission on maritime and river transport of the Scientific–Methodological Council of the Ministry of Education and Science of Ukraine on the 22nd of May, 2013. Representatives from all Ukrainian maritime higher education institutions took part in this session and discussion. The Model Course was recommended for using in study/training process.

4. Research Results

The main outcome of the research is a complex Model Course for electro-technical officers that includes the following specific outcomes:

- Course for electro-technical officer (Course for ETO) at the operational level;
- Course for Senior electro-technical officer (Course for Senior ETO);
- Training Record Book supporting the Course for ETO.

The following main components of Course for ETO and Course for Senior ETO were developed during research:

- General descriptions of ETO and Senior ETO qualifications;
- The pathway of ETO career progress;
- Entry standards for both courses;
- Course requirements for both courses;
- Competencies for ETO that are not presented in the Table A-III/6 of the STCW Code but actually are necessary to keep ETO duties at the operational level;
- Specification of Senior ETO competencies;
- Specifications of learning outcomes relating to each competence both for Course for ETO and Course for Senior ETO;
- Demonstration methods for all learning outcomes;
- Recommended list of subjects (modules) for both courses;
- Students' / trainees' workloads and appropriate course timetables for both courses;
- Descriptors for all subjects (modules) for both courses;
- Recommendations on assessment;
- Recommended list of equipment and teaching facilities.

General descriptions of ETO and Senior ETO qualifications are based on extended specification and describe: knowledge and understanding (theoretical and/or factual); skills (cognitive and practical); making judgments; communication; responsibility and autonomy. This specification allows to describe graduates' abilities more widely and to compare their qualifications and related learning outcomes with modern qualifications frameworks [9], [10].
Both Course for ETO and Course for Senior ETO as well as associated entry standards are linked to different levels of International Standard Classification of Education [11].
Specifications of competencies for both courses are based on three functions as established for ETO in the Section A-III/6 of the STCW Code.
Descriptors of subjects (modules) include lists of topics that are necessary to study appropriate subject (module) and lead to appropriate learning outcomes.
Course timetables are based on total hours needed to complete all learning activities: compulsory work placements, self-studying and individual work, preparation for assessment and assessment.
The recommended Training Record Book is a specific outcome of the research that is intended to organize combined workshop skills training and approved seagoing service in accordance with the Regulation III/6 of the STCW Convention and to assist in appropriate training programme designing.
The following components of the Training Record Book were developed during research:

- Personal details template;
- Template for workshop training records;
- Template for onboard training reviews and inspections;
- Template for a list of persons authorised to sign off onboard tasks, records and reports;
- Specification and template for shipboard and safety familiarization;
- Specification and template for ships' particulars;
- Specification and template for onboard training tasks records;
- Training Record Book Guidance.

The Complex Model Course for electro-technical officers that includes Course for ETO, Course for Senior ETO and the recommended Training Record Book is presented in Appendix F.

5. References

[1] "*International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978, as amended*", International Maritime Organization, (2011 Edition);

[2] "Report of the second ad hoc intersessional meeting of the STW Working Group on the comprehensive review of the STCW Convention and Code", *Subcommittee on standards of training and watchkeeping* - 41st session – Doc. STW 41/7/1, (2009), pp. 16-17;

[3] "Guidance relating to senior electro-technical officers" - Submitted by China, Consideration on the draft amendments to the Seafarers' Training, Certification and Watchkeeping Code, *Conference of parties to the International Convention on Standard of Training, Certification and Watchkeeping for Seafarers (STCW), 1978* – Doc. STCW/CONF.2/15 (2010);

[4] "Record of decision of the Committee of the Whole", *Conference of parties to the International Convention on Standard of Training, Certification and Watchkeeping for Seafarers (STCW), 1978* – Doc. STCW/CONF.2/CW/RD/1 (2010), p. 3;

[5] "Work Programme", *Maritime Safety Committee, 88th session* – Doc. MSC 88/23 (2010), p. 2;

[6] "Report of the Maritime Safety Committee on its eighty eighth session", – Doc. MSC 88/26 (2010), p. 91;

[7] Mykhaylo V. Miyusov, Vadym M. Zakharchenko, "Education and training of electro-technical officers and STCW Convention and Code new standards implementation", *Technical cooperation in Maritime Education and Training*, 11-th Annual General Assembly of International Association of Maritime Universities – Korea Maritime University, Busan, Korea, 2010. – p. 159 – 164;

[8] Mykhaylo V. Miyusov, Vadym M. Zakharchenko, “Study Programmes for Electro-Technical Officers Development: Two-Level Based Approach”, *Expanding Frontiers. Challenges and Opportunities in Maritime Education and Training*, 13th Annual General assembly of International Association of maritime Universities – Fisheries and Maritime Institute of memorial University of Newfoundland, St. Jones, Canada, 2012 – p. 105 – 112;
[9] “Recommendation of the European parliament and of the council of 23 April 2008 on the establishment of the European qualifications framework for lifelong learning”, (2008)
[10]“The framework of qualifications for the European Higher Education Area”, *Proc. Conference of European Ministers Responsible for Higher Education*, (2005)
[11]“*International Standard Classification of Education*”, UNESCO, (2011)

Appendix A. The first project meeting details

.1 Agenda for the first project meeting

The First Project Meeting to be held in Odessa National Maritime Academy, 8, Didrikhson Str., Odessa, Ukraine from the 5th to the 7th of July, 2012 and the following agenda was prepared:

1. Opening address of the Rector of the Odessa National Maritime Academy
2. Research Project framework
3. Proposed conception of the IAMU Model Course development
4. IAMU Model Course Structure
5. IAMU Model Course Content
6. Research schedule
7. Research tasks for all partners
8. Random

.2 Minutes of the first project meeting

Venue: Odessa National Maritime Academy
Date: 05-07 July, 2012

Participants:
Odessa National Maritime Academy
- Prof., Dr. Mykhaylo Miyusov, Rector;
- Prof., Dr. Vadym Zakharchenko, Vice-Rector, ETO;
- Capt. Dmytriy Zhukov, Senior Lecturer;
- Dr. Valeriy Lukovtsev, Dean, Faculty of Electrical Engineering & Radio-Electronics, ETO;
- Dr. Mykola Mukha, Associated Professor, ETO;
- Mr. Valeriy Shevchenko, Senior Lecturer, ETO;
- Mr. Sergey Dudko, Lecturer, ETO.

Gdynia Maritime University
- Prof., Dr. Janusz Mindykowski, Vice-Rector, ETO;
- Mr. Jacek Wyszkowski, Deputy Dean, Faculty of Marine Electrical Engineering, ETO.

Shanghai Maritime University
- Dr. Huafeng Wu, Associated Professor.

Conclusion
Having considered Agenda questions, the participants came to the following agreements:

1. Two levels of ETOs' qualifications are required to cover all corresponding ETOs' duties.
2. The IAMU Model Course for Electro-Technical Officers should be based on two-level approach.
3. The IAMU Model Course for Electro-Technical Officers should include two parts with a view of two levels of ETOs' qualifications and annexes.
4. The IAMU Model Course for Electro-Technical Officers should include the following components:
   - Course framework (objectives, entry standards, general description of learning outcomes, general description of qualification, course requirements);
   - Course outline (Specification of competences, Specification of expected learning outcomes, Descriptions of learning outcomes' demonstration methods);

- Teaching syllabus (Recommended list of subjects/modules and students'/trainees' workload; Description of subjects/modules.

5. Course outlines for both parts should be based on three functions as presented in the Table A-III/6 of the STCW Code (Electrical, Electronic and Control Engineering; Maintenance and Repair; Controlling the Operation of the Ship and Care for Persons on Board).
6. The entry requirements for the ETO Model Course should be based on requirements of ISCED level 3 or ISCED level 4 study programme.
7. Two ways of the IAMU Model Course implementation should be acceptable: as training course and as a component of ISCED level 5 or ISCED level 6 study programme.
8. For the purpose of IAMU Model Course the descriptions of learning/training outcomes should be expanded. The learning/training outcomes should reflect or be based on the following descriptors:
   - Knowledge and Understanding (theoretical and/or factual);
   - Skills (cognitive and practical);
   - Making Judgements;
   - Communication;
   - Responsibility and Autonomy.
9. The following competencies should be added to the specification of ETO's competencies:
   - Monitor the operation of bridge navigation equipment and ship communication systems (function: Electrical, Electronic and Control Engineering);
   - Use ship's computer-based maintenance planning systems (function: Maintenance and Repair);
   - Maintain the operational condition of electrical equipment of the life-saving and other safety systems (function: Controlling the Operation of the Ship and Care for Persons on Board).
10. Specifications of teaching facilities and equipment for both parts of Model Course should be combined and presented as Annex.
11. The partners should develop and send proposals concerning Course for ETO to research coordinator till September, 2012.

Appendix B. The second project meeting details

.1 Agenda for the second project meeting

The Second Project Meeting to be held in Odessa National Maritime Academy, 8, Didrikhson Str., Odessa, Ukraine from the 22nd to the 23rd of November, 2012 and the following agenda was prepared:

1. Meeting with the Rector of the Odessa National Maritime Academy
2. Project initial report; Minutes of the 13-th IAMU Annual General Assembly.
3. Introducing current draft version of IAMU Model Course for ETOs
4. Amendments to the Course Framework
5. Generic and professional competencies for ETO and Senior ETO
6. Amendments to specification of expected learning outcomes for ETO
7. Recommended List of subjects (modules) for Course for ETO
8. Descriptions of subjects (modules) for Course for ETO
9. Structure of Training Record Book for Course for ETO (proposals)
10. Specification of expected learning outcomes for Senior ETO (proposals)
11. Descriptions of subjects (modules) for Course for Senior ETO
12. Methods for demonstration and assessment of learning outcomes development (concept and proposals)
13. Specifications of teaching equipment and facilities development (concept and proposals)
14. Research tasks for all partners
15. Further joint work schedule
16. Random

.2 Minutes of the second project meeting

Venue: Odessa National Maritime Academy
Date: 22-23 November, 2012

Participants:
Odessa National Maritime Academy
- Prof., Dr. Mykhaylo Miyusov, Rector;
- Prof., Dr. Vadym Zakharchenko, Vice-Rector, ETO;
- Capt. Dmytriy Zhukov, Senior Lecturer;
- Dr. Valeriy Lukovtsev, Dean, Faculty of Electrical Engineering & Radio-Electronics, ETO;
- Dr. Mykola Mukha, Associated Professor, ETO;
- Mr. Valeriy Shevchenko, Senior Lecturer, ETO.

Gdynia Maritime University
- Prof., Dr. Janusz Mindykowski, Vice-Rector;
- Dr. Boleslav Dudojc, Deputy Dean, Faculty of Electrical Engineering, ETO.

Kerch State Maritime Technological University
- Dr. Sergey Golikov, Dean, Marine Faculty.

Conclusion
Having considered Agenda questions and current draft version of IAMU Model Course for ETOs, taking into account research objectives, the participants came to the following agreements:

1. The following aspects should be considered in the Course Frameworks for both courses:
   - the entry standards should include references to the International Standard Classification of Education – 2011;

- general description of learning outcomes for both courses should explain the role and the interrelations of different types of learning outcomes;
- general descriptions of qualifications for both courses should include general description of professional-oriented learning outcomes and generic competencies that are typical for appropriate level of qualification.

2. Specifications of generic competencies for qualification of ETO and Senior ETO which are approved by partners should be included into general descriptions of qualifications for both courses.
3. Expanded specification of professional competencies for ETO as amended at the First Project Meeting is approved by partners finally and should be included into IAMU Model Course Part 1.
4. The List of subjects (modules) for Course for ETO is approved by partners and should be included into IAMU Model Course Part 1.
5. Descriptions of subjects (modules) should include lists of topics that should be studied by a student (trainee) to cover appropriate subject and achieve appropriate learning outcomes.
6. Proposed descriptions of subjects (modules) for Course for ETO should be considered by partners additionally. The partners are invited to consider these descriptions with a view of ensuring compliance with pre-defined expected learning outcomes and send appropriate proposals to the research coordinator till the 31st of January, 2013.
7. Practical training tasks that should support Course for ETO and lead to Certificate of competency should be reflected in the Recommended Training Record Book (TRB). The recommended TRB supporting the Course for ETO should be developed by the partners and included into IAMU Model Course as annex. The partners are invited to develop appropriate proposals and send them to the research coordinator till the 31st of January, 2013.
8. Specifications of professional competencies for Senior ETO and related expected learning outcomes should be considered by partners additionally. The partners are invited to consider these specifications and send appropriate proposals to the research coordinator till 31st of December, 2012. It is recommended to invite experienced marine engineers and electro-engineers to consider these specifications.
9. Descriptions of subjects (modules) for Course for Senior ETO should be developed after approval of specifications of competencies and expected learning outcomes for Senior ETO. The partners are invited to develop appropriate proposals and send them to the research coordinator not later than at the end of February, 2013.
10. Methods for demonstration of learning outcomes should reflect how a student (trainee) should show that appropriate learning outcomes are achieved. Each learning outcome should be covered by appropriate demonstration method. Description of assessment of achieved learning outcomes should present recommended general approach to assessment with a view of autonomy of educational / training institutions and good practice in these institutions.
11. Specification of teaching equipment and facilities should include the following sections: the List of equipment, Regulatory references, Bibliography. The partners are invited to develop appropriate proposals and send them to the research coordinator not later than at the end of February, 2013.

Appendix C. The third project meeting details

.1 Agenda for the third project meeting

The Third Project Meeting to be held in Odessa National Maritime Academy, 8, Didrikhson Str., Odessa, Ukraine from the 11th to the 12th of April, 2013 and the following agenda was prepared:

1. Meeting with the Rector of the Odessa National Maritime Academy
2. Introducing the Project Report of March, 2013
3. Introducing current draft version of IAMU Model Course for ETOs
4. Amendments to the Course for ETO
5. Amendments to specification of competencies for Senior ETO
6. Amendments to specification of expected learning outcomes for Senior ETO
7. Descriptions for subjects of the Course for Senior ETO
8. Other amendments to the Course for Senior ETO
9. Course timetables (students'/trainees' workload)
10. Teaching facilities and equipment
11. Amendments to the Training Record Book structure
12. Training Record Book content (Shipboard and safety familiarization, ships' particulars, training tasks, user's guide)
13. Final Project Report structure
14. Research tasks for all partners
15. Further joint work schedule
16. Random

.2 Minutes of the third project meeting

Venue: Odessa National Maritime Academy
Date: 11-12 April, 2013

Participants:
Odessa National Maritime Academy

- Prof., Dr. Mykhaylo Miyusov, Rector;
- Prof., Dr. Vadym Zakharchenko, Vice-Rector, ETO;
- Capt. Dmytriy Zhukov, Senior Lecturer;
- Dr. Valeriy Lukovtsev, Dean, Faculty of Electrical Engineering & Radio-Electronics, ETO;
- Dr. Mykola Mukha, Associated Professor, ETO;
- Mr. Valeriy Shevchenko, Senior Lecturer, ETO.

Gdynia Maritime University

- Prof., Dr. Janusz Mindykowski, Vice-Rector;
- Mr. Jacek Wyszkowski, Deputy Dean Faculty of Marine Electrical Engineering, ETO.

Conclusion
Having considered Agenda questions and current draft version of IAMU Model Course for ETOs, taking into account research objectives and term of research project deadline, the participants came to the following agreements:

1. The Course for ETO as amended during the third project meeting is approved by partners as a whole and must be included into the final edition of the Model Course.

2. Specifications of competencies and linked learning outcomes of the Course for Senior ETO as amended during the third project meeting are approved by partners and must be included into the final edition of the Course for Senior ETO.
3. The List of subjects (modules) and description of subjects of the Course for Senior ETO as amended during the third project meeting are approved by partners and must be included into the final edition of the Course for Senior ETO.
4. Student's (trainee's) workload should reflect total hours that include all kinds of learning activities - hours for lectures, laboratory and practical works, workshops, seminars, individual tasks and projects, self-study and examinations.
5. Distribution of student's (trainee's) workload should be based on modular principle. Each subject (module) should have 30-hour volume or multiples of it.
6. Recommended Training Record Book should include following components:
   - Guidance;
   - Student/trainee personal details;
   - Workshop training records;
   - Onboard training reviews and inspections;
   - List of persons authorized to sign off onboard tasks, records and reports;
   - Shipboard and safety familiarization;
   - Ships' particulars;
   - Onboard training tasks' performance.
7. Content of shipboard and safety familiarization, ships' particulars, training tasks, user's guide as amended during the third project meeting are approved by partners and must be included into the final edition of the recommended Training Record Book.
8. The draft of specification of teaching equipment and facilities may be accepted but should be considered and/or reviewed additionally. The partners are invited to consider this specification and send appropriate proposals to the research coordinator till the 30th of April, 2013.
9. The partners are invited to review IAMU Model Course as a whole and send any remarks, corrections and/or proposed amendments to the research coordinator till the 12th of May, 2013.
10. The IAMU Model Course for Electro-Technical Officers and Final Project Report should be based on approved during the third project meeting the Course for ETO, the Course for Senior ETO, the Training Record Book and the Specification of teaching equipment and facilities with taking into account proposals that may be sent by the partners after the third project meeting but not later than on the 12th of May, 2013.

Appendix D. Research questionnaires

.1 The first stage of research

General conception of IAMU Model Course

- What is the pathway of ETO carrier development?
- How many levels of ETOs' ranks are accepted in different national certification systems?
- How many levels of ETOs' qualifications are required to cover all ETOs' duties?

IAMU Model Course Structure

- How many levels of ETO qualifications should be reflected in the Model Course?
- How should all necessary levels of ETO qualifications be reflected in the Model Course?
- Which components of study/training programmes or ETOs should be reflected in the Model Course?

IAMU Model Course Content

- How are professional-oriented training outcomes related to university study programmes learning outcomes?
- Should the Model Corse relate to study programmes of higher education?
- How should training course be implemented into university study programmes?
- Do knowledge, understanding and proficiency that are presented in STCW Code fully describe ETO qualification?
- Which additional training (learning) outcomes are necessary for developing comprehensive descriptions of ETO qualifications?
- Which generic competencies are related to each level of ETOs qualifications?
- Which level or levels of ISCED study programmes should the Model Course correspond to?
- Which components of the Model Course should be presented separately for each level of ETO qualification?
- Which components of the Model Course should be combined as a joint part of all ETO qualifications?

.2 The second stage of research

IAMU Model Course Structure

- How should the methods for demonstration of learning outcomes and the methods of assessment be presented?
- What study workload of the students (trainees) should be? How should study workload be reflected in IAMU Model Course?
- How should practical training tasks be presented within Course for ETO?

IAMU Model Course Content

- Does the proposed specification of expected learning outcomes for ETO correspond to general description of ETO qualification and established ETO's competencies?
- How should each recommended subject (module) be described?
- Do currently proposed topics in subject descriptions within Course for ETO correspond to appropriate subjects (modules) and lead to defined expected learning outcomes?
- Which subjects (topics) should be supported by onboard and/or workshop training and should be included into recommended Training Record Book?
- What is the general description of Senior ETO qualification? Does proposed draft description correspond to Senior ETO's tasks and duties?

- What are the competencies for Senior ETO qualification? Whether proposed competencies correspond to the Senior ETO' tasks and duties?
- What are the expected learning outcomes for Senior ETO qualification?
- What are recommended subjects (modules) for Course for Senior ETO? How is appropriate training provided in partner universities?

.3 The third stage of research

Course for Senior ETO

- Do the proposed specifications of competencies and expected learning outcomes for Senior ETO correspond to general description of Senior ETO qualification and appropriate onboard duties?
- Does the currently proposed list of subjects (modules) for the Course for Senior ETO correspond to Senior ETO duties and accepted specification of Senior ETO competencies?
- Do the currently proposed topics for the Course for Senior ETO correspond to appropriate subject (module) and lead to defined expected learning outcomes?

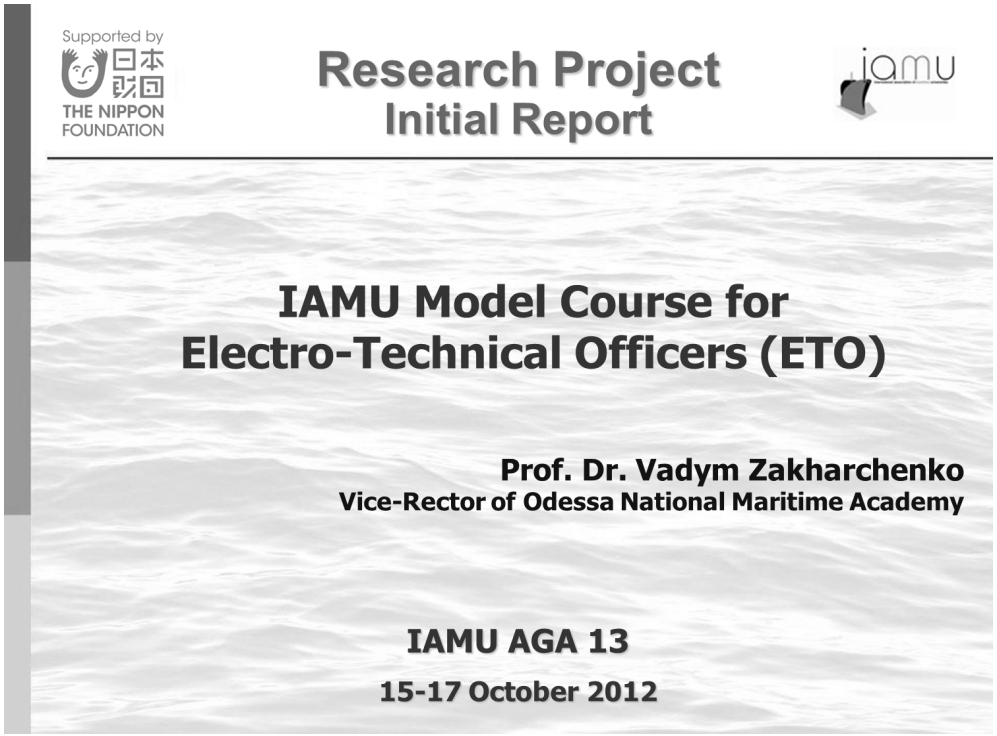
Course timetables

- How many total hours are necessary for studying the Course for ETO and the Course for Senior ETO?
- How many total hours are necessary for studying each subject of the Course for ETO and the Course for Senior ETO?
- How should total hours be distributed between subjects for both courses?
- Is it expedient to use the modular principle of distribution? What base volume of the module (subject) should be accepted?

Training Record Book

- Does the proposed Training Record Book structure reflect both onboard and workshop training tasks and reflect inspections by training officers, ship administration and company responsible persons?
- What should be included mandatory into shipboard and safety familiarization for electro-technical cadet?
- Which ships' particulars are obligatory for studying by electro-technical cadet?
- Which training tasks are necessary for electro-technical cadet for support of theoretical knowledge and achievement of proficiency required?

Appendix E. Presentation for IAMU AGA 13



Supported by THE NIPPON FOUNDATION

Research coordinator

jamu

Name and position: **Prof. Dr. Vadym Zakharchenko**
Vice-Rector of Odessa National Maritime Academy
IMO Competent Person

Specializations: **Marine Electrical Engineering,**
Standards and Programmes Designing

Member University: **Odessa National Maritime Academy**

Post Address: **Odessa National Maritime Academy**
8, Didrikhson str., Odessa, 65029, Ukraine

Phone, Fax and e-mail: **+38 048 728 31 57 (Phone/Fax)**
+38 066 754 96 72 (mob)
zvn@onma.edu.ua

Supported by THE NIPPON FOUNDATION

Research partners

jamu

Name and position: **Prof. Dr. Janusz Mindykowski**
Vice-Rector of Gdynia Maritime University
Specializations: **Marine Electrical Engineering,**
Responsible task:: **Project Coordinator of EU Region**
e-mail: **janmind@am.gdynia.pl**

Name and position: **Dr. RUAN WEI**
Director of Shanghai Seafarer Training Center
Shanghai Maritime University
Specializations: **Marine Training Programmes Designing ,**
Responsible task:: **Project Coordinator of Asia Pasific Region**
e-mail: **weiruan-smu@163.com**

Supported by 日本財団 THE NIPPON FOUNDATION

Research backgrounds (1)

- The Manila amendments to the Annex to the STCW Convention and STCW Code were approved in 2010. Manila amendments took force at 01 Jan 2012;
- The standards regarding Electro-Technical Officers (ETO) are established by Regulation III/6 of the Annex STCW Convention and Sections A-III/6 and B-III/6 of the STCW Code;
- These standards are first international standards regarding ETO
- Model Course for ETO is one of the main needs for Maritime educational and training institutions.

Supported by 日本財団 THE NIPPON FOUNDATION

Research backgrounds (2)

- The standards regarding ETO established in the STCW Convention and STCW Code are one-level standards and correspond to operational level;
- These standards do not cover a wide range of competencies that are necessary in modern marine engineering;
- During the process of comprehensive review of the STCW Convention and STCW Code delegations of large number of countries have been supported the idea of two-levels standards for ETO: standards regarding ETO and standards regarding Senior ETO.

Supported by THE NIPPON FOUNDATION

Research backgrounds (3)

- STCW Conference in Manila invited the Maritime Safety Committee to consider proposal relating Senior ETO with a view to establishing a new work programme item for the STW Sub-Committee (STCW/CONF.2/CW/RD/1);
- The Maritime Safety Committee invited Member Governments and international organizations to submit proposals relating Senior ETO (MSC 88/26).

Supported by THE NIPPON FOUNDATION

Research backgrounds (4)

- IMO Model Course for ETO is expected next year;
- IMO Model Course will correspond to one-level standards established in the STCW Convention and STCW Code;
- The STCW standards and expected IMO Model Course for ETO do not contain the higher competence requirements and do not take into account situations when 2 levels of ETO qualifications are necessary.

- IAMU Model course for ETO is a main goal of the project;
- 2 levels-based approach is main feature of the research project.

Supported by THE NIPPON FOUNDATION

Reasons

jamu

What is the reasons of 2 levels?

Development of technologies

- complexity and wide range of the equipment relevant to the ETOs responsibilities; and
- fast development of technologies

lead to the growth of the requirements to the ETO qualification.

Management of electro-technical groups

- on some certain vessel types (special purpose vessels, vessels with powerful and complex electrical power plants) electro-technical competences are provided by electro-technical groups that might include a few electro-technical officers and number of electro-technical ratings. Management level tasks appear in this situations.

Supported by THE NIPPON FOUNDATION

Work Schedule of the Research Project (1)

jamu

Item No	FY	Item	2012	2012	2012	2012	2012	2012	2012	2012	2013	2013	2013	2013	2013
1	FY 2012	Collecting information	May												
2		1st Project Meeting		June											
3		Collecting and analysis additional information			July	Aug									
4		Prepare Project Interim Report for AGA13					Sep								
5		Presentation of Interim Report, AGA13, Canada						Oct							
6		2nd Project Meeting							Nov						
7		Preparing the materials for the final report								Dec	Jan				
8		3rd Project Meeting										Feb			
9		Preparing the final report and support material											Mar	Apr	
10	FY 2013	Final Report to Secretary Office(End of research)													May

Supported by THE NIPPON FOUNDATION

Work Schedule of the Research Project (2)

iamu

Main items

- **Collecting and analysis information;**
- **3 Project Meeting (Jul 2012, Nov 2012, Feb 2013);**
- **Project Interim Report for AGA13;**
- **Preparing the materials for the final report (Dec 2012);**
- **Preparing the final report and support material (Apr 2013);**
- **Final Report to Secretary Office - End of research (May 2013).**

Supported by THE NIPPON FOUNDATION

Description of work

iamu

The research participants prepare the algorithm for collect and analyze the necessary information.

The research participants have to create structure of IAMU Model Course for ETO and have to develop all components of this Model Course.

The IAMU Model Course for ETO should be developed with a view of 2 levels of ETO qualifications and should foresee for:

- advanced knowledge,
- ability to adapt to the fast development of technologies,
- ability to manage complex technical activities,
- ability to take responsibility for decision-making,
- ability to manage professional development of personnel.

Supported by THE NIPPON FOUNDATION

Minutes of the 1-st Project Meeting

jamu

Venue: **Odessa National Maritime Academy** ***Date::*** **05-07 July, 2012**

Present:

Project Coordinator - Prof. Dr. Vadym Zakharchenko, *ONMA*;
Research Partners Prof. Dr. Janusz Mindykowski, *GMU*;
Dr. Huafeng Wu, *SMU*.

Participants

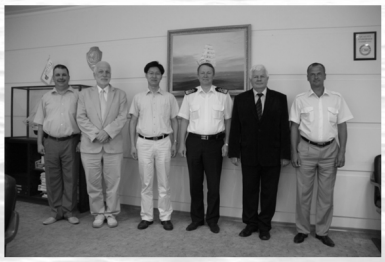
Odessa National Maritime Academy:
Capt. Dmytriy Zhukov, Senior Lecturer;
Dr. Valeriy Lukovtsev, Dean, Faculty of Electrical Engineering, ETO;
Dr. Mykola Mukha, Associated Professor, ETO;
Mr. Valeriy Shevchenko, Senior Lecturer, ETO;
Mr. Sergey Dudko, Lecturer, ETO

***Gdynia Maritime University*:**
Mr. Jacek Wyszkowski, Deputy Dean, Faculty of Marine Electrical Engineering, ETO.

Supported by THE NIPPON FOUNDATION

Minutes of the 1-st Project Meeting

jamu



Supported by THE NIPPON FOUNDATION

1-st Project Meeting Outcomes

jamu

- Research Questionnaire
- Model Course Structure
- Course Framework
- Structure of Course outline
- Draft Specification of Competencies
- Structure of Teaching Syllabus

Supported by THE NIPPON FOUNDATION

Research Questionnaire

jamu

- Descriptions of qualifications;
- Competencies and linked learning outcomes that are necessary for ETO but not presented in the STCW Code Sections A-III/6 & B-III/6;
- Competencies for Senior ETO and supporting expected learning outcomes;
- Methods for demonstrating of learning outcomes and appropriate methods of assessment;
- Equipment & facilities that should be recommended for ETO and Senior ETO courses.

Supported by THE NIPPON FOUNDATION

Model Course Structure

- **Part 1. Course for Electro-Technical Officer**
- **Part 2. Course for Senior Electro-Technical Officer**

Each part contains:

- **Course framework**
  - **Course objectives**
  - **Entry standards**
  - **General description of qualification**
- **Course outline**
  - **Specification of competences,**
  - **Expected learning outcomes,**
  - **Assessment of learning outcomes**
- **Teaching syllabus**
  - **Recommended List of modules and timetable,**
  - **Description of modules,**
  - **Teaching facilities and equipment**

Supported by THE NIPPON FOUNDATION

Entry standards

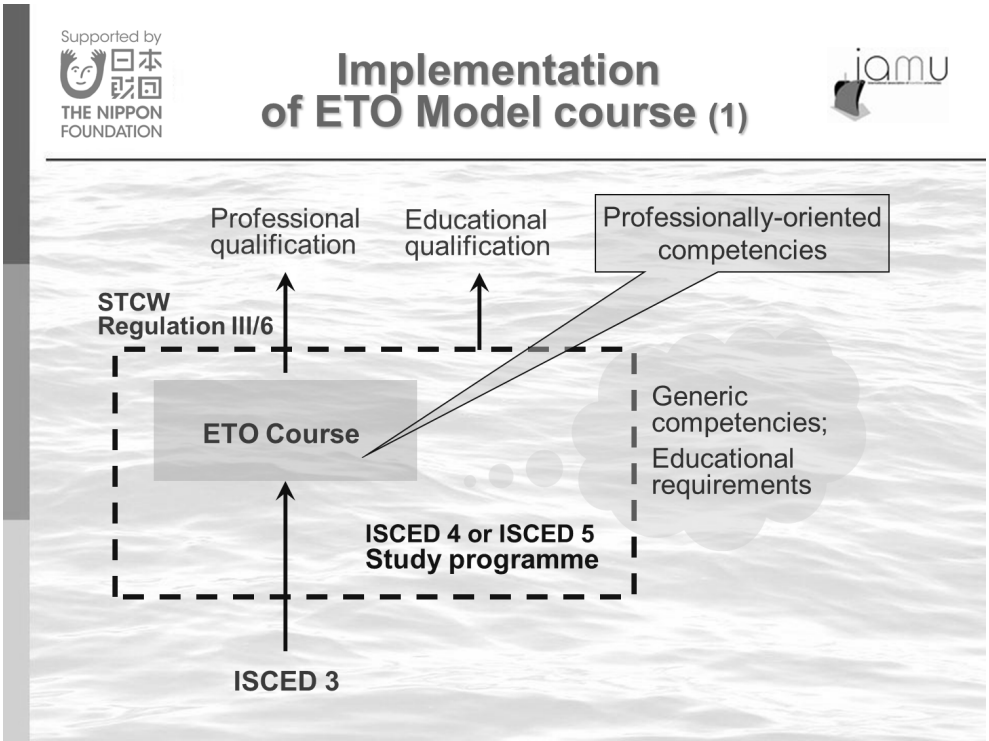
Course for Electro Technical Officer

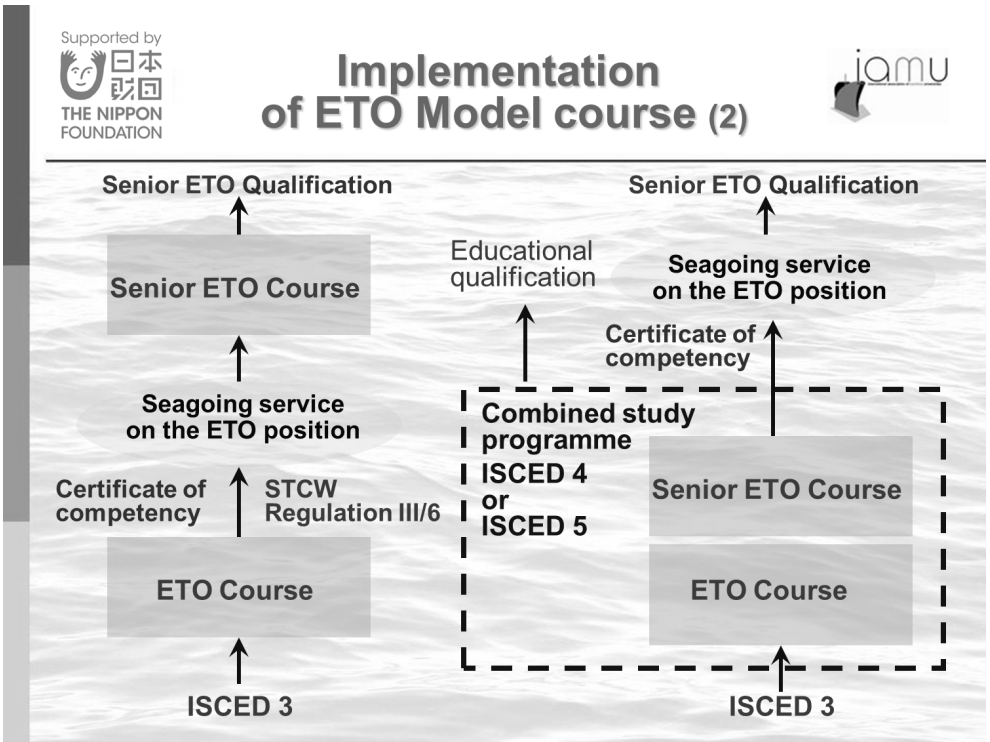
- the entry age should be at least 16 years;
- completed ISCED level 3 programme before admission;
- appropriate knowledge in mathematics and physical science;
- ability to oral and written communication and interpersonal skills;
- elementary computing skills;
- capacity to learn.

Course for Senior Electro Technical Officer

- completed Course for electro-technical officer before admission;
-it is desirable to have seagoing service experience on the ETO position.

ISCED - International Standard Classification of Education


Supported by
THE NIPPON FOUNDATION
Implementation of ETO Model course (1)
jamu
Professional qualification
Educational qualification
Professionally-oriented competencies
STCW Regulation III/6
ETO Course
Generic competencies;
Educational requirements
ISCED 4 or ISCED 5 Study programme
ISCED 3


Supported by
THE NIPPON FOUNDATION
Implementation of ETO Model course (2)
jamu
Senior ETO Qualification
Senior ETO Course
Seagoing service on the ETO position
Certificate of competency
STCW Regulation III/6
ETO Course
ISCED 3
Senior ETO Qualification
Educational qualification
Seagoing service on the ETO position
Certificate of competency
Combined study programme
ISCED 4 or ISCED 5
Senior ETO Course
ETO Course
ISCED 3

Supported by 日本財団 THE NIPPON FOUNDATION

Descriptors of qualifications

iamu

STCW descriptors (KUP)

- Knowledge;
- Understanding;
- Proficiency

IAMU Model Course descriptors

- Knowledge and Understanding (theoretical and/or factual);
- Skills (cognitive and practical);
- Making Judgements;
- Communication;
- Responsibility and Autonomy

Supported by 日本財団 THE NIPPON FOUNDATION

General Description of ETO Qualification

iamu

- Comprehensive, specialized knowledge and understanding in the field of marine electrical engineering, electronics and automation and basic knowledge in the fields of ships design and marine mechanical engineering;
- Ability to identify and use data to formulate responses and to develop creative solutions to problems in the field of marine electrical engineering, electronics and automation;
- Ability to communicate about their understanding, skills and activities with peers and managers;
- Ability to manage and supervise small groups;
- Ability to review and develop performance of self and others.

Direct labor market entry after certification in accordance to the regulation III/6 of the STCW Convention.

Supported by 日本財団 THE NIPPON FOUNDATION

General Description of Senior ETO Qualification

jamu

- Advanced and forefront knowledge in the field of marine electrical engineering, electronics and automation;
- Ability to gather and interpret relevant data to make judgments and to solve complex and unpredictable problems in field of marine electrical engineering, electronics and automation ;
- Ability to communicate about information, problems, judgments, ideas and solutions with supervisors, managers and subordinated personnel;
- Ability to manage complex professional activities in the field of marine electrical engineering, electronics and automation;
- Ability to organize training of shipboard personnel and to manage professional development of subordinated groups.

Direct labor market entry after certification in accordance to the regulation III/6 of the STCW Convention or national regulations.

Supported by 日本財団 THE NIPPON FOUNDATION

General Description of Senior ETO Qualification

jamu

- **Advanced and forefront knowledge;**
- **Ability to solve complex and unpredictable professional problems ;**
- **Ability to manage complex professional activities;**
- **Communication and management skills are wider than for ETO.**

Supported by 日本財団 THE NIPPON FOUNDATION

Competencies of ETO (1)

jamu

Function: Electrical, Electronic and Control Engineering

- Monitor the operation of electrical, electronic and control systems;
- Monitor the operation of automatic control systems of propulsion and auxiliary machinery;
- Monitor the operation of bridge navigation equipment and ship communication systems;
- Operate generators and distribution systems;
- Operate and maintain power systems in excess of 1,000 volts;
- Operate computers and computer networks on ships;
- Use English in written and oral form;
- Use internal communication systems.

Supported by 日本財団 THE NIPPON FOUNDATION

Competencies of ETO (2)

jamu

Function: Maintenance and Repair

- Maintenance and repair of electrical and electronic equipment;
- Maintenance and repair of automation and control systems of main propulsion and auxiliary machinery;
- Maintenance and repair of bridge navigation equipment and ship communication systems;
- Maintenance and repair of electrical, electronic and control systems of deck machinery and cargo-handling equipment;
- Maintenance and repair of control and safety systems of hotel equipment;
- Use ships computer-based maintenance planning systems.

Supported by THE NIPPON FOUNDATION

Competencies of ETO (3)

jamu

Function: Controlling the Operation of the Ship and Care for Persons on Board

- Ensure compliance with pollution prevention requirements;
- Prevent, control and fight fire on board;
- Operate life-saving appliances;
- Apply medical first aid on board ship;
- Apply leadership and teamworking skills;
- Contribute to the safety of personnel and ship.
- Maintain the operational condition of electrical equipment of the life saving and other safety systems.

Supported by THE NIPPON FOUNDATION

Competencies of Senior ETO (1)

jamu

Function: Electrical, Electronic and Control Engineering

- Monitor and evaluate electrical power generation and consumption;
- Monitor and adjust all electrical, electronic equipment and control systems, evaluate and predict its condition;
- Plan, schedule and manage complex activities to provide correct operation of electrical, electronic equipment and control systems;
- Operate specific electrical equipment and integrated control systems;
- Operate safely power system in excess of 1000 volts;
- Operate all kinds of electrical and electronic equipment, electrical power plants in unpredicted and emergency situations

Supported by 日本財団 THE NIPPON FOUNDATION

Competencies of Senior ETO (2)

jamu

Function: Maintenance and Repair

- Plan, schedule and manage maintenance and repair activities;
- Testing integrated control and monitoring systems;
- Manage troubleshooting restoration of electrical, electronic equipment and control systems to operating condition;
- Detect and identify causes of malfunctions in electrical and electronic equipment;
- Organize recovery electrical power plants and integrated control systems after accidents;
- Define necessary spare parts for electrical and electronic equipment;
- Ensure safe working practices.

Supported by 日本財団 THE NIPPON FOUNDATION

Competencies of Senior ETO (3)

jamu

Function: Controlling the Operation of the Ship and Care for Persons on Board

- Manage and supervise complex activities of electro-technical personnel;
- Use leadership and managerial skills;
- Monitor and control compliance with legislative requirements and measures relating to electrical and electronic equipment to ensure safety of life at sea and protection of the maritime environment;
- Manage development professional knowledge and skills of electro-technical personnel;
- Organize training of shipboard personnel relating to operation electrical and electronic equipment including emergency situation;

Competencies of Senior ETO (4)

Function: Controlling the Operation of the Ship and Care for Persons on Board (continuation)

- Develop emergency and damage control plans and handle emergency situation relating to electrical equipment;
- Maintain safety and security of the ship's crew and passengers and the operational condition of the life saving, fire fighting and other safety systems.

Following steps

Now in progress

- List of expected learning outcomes;
- Recommended list of modules;
- Course timetable.

Next

- Methods for demonstration and assessment of learning outcomes;
- Recommended specification of teaching equipment and facilities.


Supported by
日本財団
THE NIPPON FOUNDATION
iamu
Thank you for attention!
Vadym Zakharchenko
Odessa National Maritime Academy
Vice-Rector
zvn@onma.edu.ua
+38-048-728-31-57

Appendix F

MODEL COURSE

for

ELECTRO-TECHNICAL OFFICERS

Developed for

International Association of Maritime Universities

by

Odessa National Maritime Academy

Gdynia Maritime University

Shanghai Maritime University

Contents

Introduction to the Model Course 37

Part 1 Course for Electro-Technical Officer 39

1.1 Course framework 39

1.2 Course outline 42

1.2.1 Function: Electrical, Electronic and Control Engineering 42

1.2.2 Function: Maintenance and Repair 46

1.2.3 Function: Controlling the Operation of the Ship and Care for Persons on Board 50

1.3 Teaching syllabus 53

1.3.1 List of subjects and students'/trainees' workload 53

1.3.2 Description of subjects 56

1.3.3 Assessment 70

Part 2 Course for Senior Electro-Technical Officer 72

2.1 Course framework 72

2.2 Course outline 75

2.2.1 Function: Electrical, Electronic and Control Engineering 75

2.2.2 Function: Maintenance and Repair 79

2.2.3 Function: Controlling the Operation of the Ship and Care for Persons on Board 82

2.3 Teaching syllabus 85

2.3.1 List of subjects and students'/trainees' workload 85

2.3.2 Description of subjects 87

2.3.3 Assessment 97

Annex A Training Record Book 99

1 Guidance 99

2 Personal details 101

3 Workshop training 102

3.1 Workshop training summary 102

3.2 Tasks description and performance 103

4 Onboard training 106

4.1 Seagoing service summary 106

4.2 Seagoing service testimonials 108

4.3 Inspection by company training officer 111

4.4 Inspection by Chief engineer 112
4.5 Review by onboard training officer 113
5 Specimen signatures of officers and other experienced staff authorised to sign off tasks, records and reports 114
6 Shipboard and safety familiarization 119
7 Ships' particulars 120
8 Training tasks performance 124
8.1 Function: Electrical, Electronic and Control Engineering 124
8.2 Function: Maintenance and Repair 128
8.3 Function: Controlling the Operation of the Ship and Care for Persons on Board 131
Annex B Teaching facilities and equipment 133

Introduction to the Model Course

- **Purpose of the Model Course**

The purpose of this IAMU Model Course is to assist maritime universities and other maritime training institutions and their teaching staff in designing study/training programmes leading to qualifications of electro-technical officers and in organizing workshop and onboard training. It is not the intention of the Model Course to present instructors with a rigid “teaching package" which they are expected to “follow blindly".

This is the first edition of this Model Course. In order to keep the study/training programme up to date in future, it is essential that users provide feedback. New information will provide development of the Model Course content with a view of improving professional training, ensuring safety at sea and protection of the marine environment. Information, comments and suggestions should be sent to the Odessa National Maritime Academy (Ukraine), Gdynia Maritime University (Poland) and Shanghai Maritime University (China).

- **Structure of the Model Course**

The Model Course includes two courses (Course for Electro-Technical Officer and Course for Senior Electro-Technical Officer) and recommended Training Record Book.

Course for Electro-Technical Officer and Course for Senior Electro-Technical Officer have different objectives and entry standards and are related to two levels of electro-technical officers’ qualifications. First course corresponds to the requirements established for electro-technical officers in the Seafarers’ Training, Certification and Watchkeeping Code. Second course corresponds to advanced competencies that are required for providing complex technical and professional activities and management tasks.

Both of courses are presented in “learning outcomes” format and each expected learning (training) outcome specifies what the graduates must know, understand and be able to do. Taken as a whole, achievement of specified expected learning outcomes allows graduate to meet the requirements of appropriate qualification.

The educational systems and the cultural backgrounds of students (trainees) vary considerably from country to country. For this reason the Model Course material has been designed to identify the basic entry requirements and students (trainees) target group for each course in universally applicable terms, and to specify clearly the content and levels of knowledge and skills necessary to meet the course objectives. Entry requirements are based on the International Standard Classification of Education (ISCED - 2011).

- **Use of the Model Course**

Both of presented courses may be delivered in two ways: as separated training course leading to professional qualification only or as a part of study programme leading also to appropriate educational qualification.

To use the Model Course the tutors (instructors) should review the course outline and teaching syllabus, taking into account the information provided under the entry standards and description of qualification specified in the course framework. The actual level of knowledge and skills and the prior education of students (trainees) should be kept in mind during this review, and any areas within the teaching syllabus which may cause difficulties, because of differences between the actual students (trainees) entry level and that assumed by the course (programme) designer should be identified. Tutors (instructors) should also identify any academic knowledge, skills or technical training which they may not have acquired. By analysing the teaching syllabus, the academic knowledge and

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

Adjustment of the course objectives and content may also be necessary if in accordance to national or company requirements the course graduates have to undertake duties which differ from the course objectives specified in the Model Course.

The study/training programme designers have indicated their assessment of the time which should be allocated to each learning topic taking into account proposed course timetables. However, it must be appreciated that these allocations are arbitrary and assume that the students (trainees) have fully met all entry requirements of the course. The tutor (instructor) should therefore review these assessments and may need to reallocate the time required to achieve each specific learning objective or learning (training) outcome.

- **Presentation of the Model Course**

The presentation of course concepts and methodologies must be repeated in various ways until the tutor (instructor) is satisfied, by testing and evaluating the student's (trainee's) performance and achievements.

As in all education and training endeavors, the competency of the tutors and instructors is the key component in the transfer of knowledge, understanding and skills to students (trainees). Tutors and instructors shall be qualified in the subject/ task for which studying/training is being conducted and have completed appropriate training in teaching and/or training techniques.

Part 1 Course for Electro-Technical Officer

1.1 Course framework

- **Objectives**

This course aims are to ensure professional-oriented specialized knowledge, understanding, cognitive and practical skills to support the competencies of ship's electro-technical officer.
This course covers the standards of competencies of the STCW Code Sections A- III/6 & B-III/6.
This course is principally intended for candidates for certification as electro-technical officers. It is expected that graduates who completed this course successfully and have appropriative workshop skills training and approved seagoing service will get certificate of competency in accordance with the regulation III/6 of the STCW Convention.
This course can not be regarded as tertiary programme directly. At the same time it is possible to implement this course as a part of university study programme leading to appropriate qualification (degree) as illustrated in the fig. 1.1.

- **Entry standards**

The entrants should be typically older than those in upper secondary programmes. It is expected that in most cases the entry age will be at least 16 years.
It is envisaged that students (trainees) will have completed ISCED level 3 programme before admission. It is acceptable if students (trainees) have completed previously educational programme at ISCED level 3* (Upper secondary general or Upper secondary vocational) or ISCED level 4* (Postsecondary non-tertiary general or Postsecondary non-tertiary vocational).
The following Subcategories of ISCED level 3 programmes are accepted:
Upper secondary general programmes:
344 - sufficient for level 3 completion, with direct access to tertiary [may also give direct access to ISCED level 4];
Upper secondary vocational programmes:
354 - sufficient for level 3 completion, with direct access to tertiary [may also give direct access to ISCED level 4].
The following Subcategories of ISCED level 4 programmes are accepted:
Postsecondary non-tertiary general programmes
444 - sufficient for level 4 completion, with direct access to tertiary;
Postsecondary non-tertiary vocational programmes
454 - sufficient for level 4 completion, with direct access to tertiary.
No previous maritime or engineering training is assumed, but those entering the course should follow an approved programme of shipboard training.
It is expected that students (trainees) are competent in oral and written communication in native language and have elementary computing skills, capacity to learn and interpersonal skills.
Attention is drawn to the fact that students (trainees) continually use fundamental mathematics as a tool throughout the whole course; also, as the principles of applied science and engineering are included at an early stage, it is essential to ascertain the potential and interest in this kind of work before entry. In a similar manner, trainees have to accomplish a range of engineering craft skills, and therefore an aptitude and interest in this field are also necessary.
If entrants have not reached the required standards in mathematics or physical science it will be necessary to provide a preparatory course or courses to bring them to the desired level before starting the professional studies.

*) References to the International Standard Classification of Education – 2011

- **Learning outcomes**

Learning outcomes describe what a student (trainee) is expected to know, understand and be able to do after successful completion of the learning (training) process. The few types of learning outcomes descriptions are used: General learning outcomes: Learning outcomes at the level of functions and competencies; Learning outcomes at the level of subject (module).
General learning outcomes describe the Course and Qualification as a whole. General learning outcomes of this Course are described in the section "Description of qualification".
Learning outcomes at the level of functions and competencies usually combine outcomes of one or few subjects. These learning outcomes are defined for each competence and presented in sections "Expected learning outcomes" in paragraphs 1.2.1, 1.2.2 and 1.2.3 of this Course.
Learning outcomes at the level of subject can contain the number of outcomes of different topics, exercises, etc. These learning outcomes shall be defined more detailed than at the level of functions and competencies. It is expected that learning outcomes of each subject shall be defined by educational (training) institution depending of accepted curriculum, descriptions of subjects and used facilities.

- **Description of qualification**

This course is not leading to qualification of tertiary education directly.
This course is oriented to the technical education. It is envisaged that graduates who will have completed this course successfully will have direct labour market entry after certification in accordance with the regulation III/6 of the STCW Convention.
Graduates should be capable to carry out duties of electro-technical officer related to 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 operational level as presented in the STCW Code Sections A- III/6 & B-III/6.
In a case of implementation this course as a part of ISCED level 5* or ISCED level 6* study programme graduates can achieve appropriate educational qualification**,** as illustrated in the fig. 1.1.
The qualification related to this course may be described by the following learning outcomes:

- Comprehensive, specialized factual and theoretical knowledge and understanding in the field of marine electrical engineering, electronics and automation and basic knowledge of the interfaced fields;
- Ability to identify and use data to formulate responses and to develop solutions to problems in the field of marine electrical engineering, electronics and automation where unpredictable changes are possible;
- Ability to communicate about their understanding, skills and activities with subordinate, peers and managers;
- Ability to manage and supervise of small groups;
- Ability to review and develop performance of self and subordinated personnel.

The qualification should be supported by the following generic competences:

- Capacity for applying knowledge in practice;
- Planning and time management;
- Grounding in basic knowledge of the profession in practice;
- English communication;
- Team-working;
- Decision-making in predicted situations;
- Understanding of cultures and customs of other countries;
- Ability to work autonomously;

*) References to the International Standard Classification of Education – 2011

- Ethical commitment;
- Concern for quality.

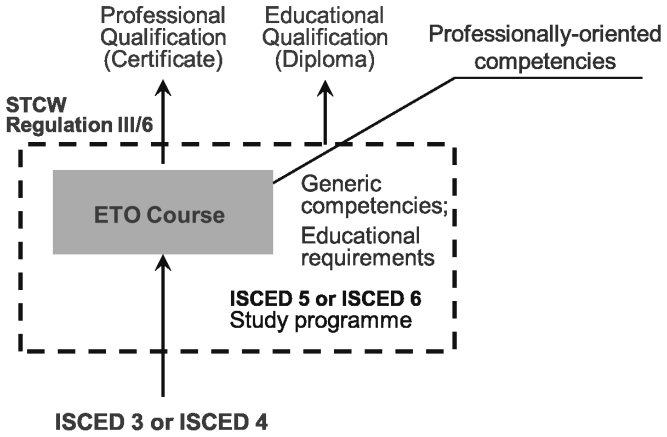


Fig. 1.1 Implementation of ETO course

- **Course requirements**

Study process must include contact hours and individual work. Individual work should include self-studying and carrying out individual tasks.
During self-studying students should learn theoretical material and prepare for workshops, laboratory and practical exercises, exams using textbooks and available facilities.
Lectures, workshops, laboratory and practical exercises should be provided in classrooms, laboratories and simulators. It is recommended to deliver lectures by professors or leading experts in corresponding subject.
During laboratory exercises students must carry out observations or experiments under tutor supervising for proving theoretical statements.
When carrying out individual tasks (projects or tests) a student should individually solve theoretical or practical problems issued by tutor. Individual tasks should be fulfilled autonomously with tutorial. The subjects and content of individual tasks should be defined by educational/training institution depending on methodological and technical basis and on the level of study programme.
It is expected that course should be divided into a number of separated subjects or modules and learning outcomes of each of them should be assessed.
It is recommended to carry out comprehensive assessment at the end of the course for defining achieved learning outcomes.
The course must include not less than 12 months of combined workshop skills training and approved seagoing service of which not less than 6 months must be seagoing service which meets the requirements of the regulation A-III/6 of the STCW Convention.
Recommended Training record book is described in the Annex A of the MODEL COURSE for ELECTRO-TECHNICAL OFFICERS.

1.2 Course outline

This chapter is divided on three functions. Each of them is based on the list of professionally-oriented competencies.

1.2.1 Function: Electrical, Electronic and Control Engineering

- **Specification of competences**

1.1 MONITOR THE OPERATION OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS
1.2 MONITOR THE OPERATION OF AUTOMATIC CONTROL SYSTEMS OF PROPULSION AND AUXILIARY MACHINERY
1.3 OPERATE GENERATORS AND DISTRIBUTION SYSTEMS
1.4 OPERATE AND MAINTAIN POWER SYSTEMS IN EXCESS OF 1,000 VOLTS
1.5 OPERATE COMPUTERS AND COMPUTER NETWORKS ON SHIPS
1.6 USE ENGLISH IN WRITTEN AND ORAL FORM
1.7 USE INTERNAL COMMUNICATION SYSTEMS
1.8 MONITOR THE OPERATION OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS

- **Expected learning outcomes**

1.1 MONITOR THE OPERATION OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS

1.1.1 Knowledge and understanding of electro-technology fundamentals and ability to apply their basic laws
1.1.2 Knowledge and understanding of electrical materials technology
1.1.3 Knowledge and understanding of electrical machines theory
1.1.4 Knowledge and understanding of electronics and power electronics fundamentals
1.1.5 Knowledge and understanding of ships design and propulsion
1.1.6 Knowledge and understanding of heat transmission, mechanics and hydromechanics and understanding of their basic laws
1.1.7 Knowledge and understanding of the operation, processes and important parameters of mechanical engineering systems:
.1 prime movers, including main propulsion plant
.2 engine-room auxiliary machinery
.3 steering systems
.4 cargo handling systems
.5 deck machinery
.6 hotel systems
1.1.8 Knowledge and understanding of electrical drives theory. Ability to appreciate correct operation of electrical drives
1.1.9 Knowledge of construction and operation principles of electrical power distribution boards and electrical equipment. Ability to define their proper operation
1.1.10 Knowledge and understanding of automation, automatic control systems and technology. Ability to define quality of control process
1.1.11 Ability to gather and interpret sensor and instrument readings for appreciation of equipment condition
1.1.12 Knowledge and understanding of instrumentation, alarm and monitoring systems. Application of such systems in whole monitoring process
1.1.13 Knowledge and understanding of electro-hydraulic and electro-pneumatic control systems

1.2 MONITOR THE OPERATION OF AUTOMATIC CONTROL SYSTEMS OF PROPULSION AND AUXILIARY MACHINERY

1.2.1 Knowledge and understanding of construction, operation principles, procedures and ability to prepare control systems of propulsion and auxiliary machinery for operation
1.2.2 Ability to appreciate of condition of automatic control systems of propulsion and auxiliary machinery
1.2.3 Knowledge and understanding of construction and operating principle of Dynamic Positioning Systems

1.3 OPERATE GENERATORS AND DISTRIBUTION SYSTEMS

1.3.1 Factual knowledge of procedures and ability to make coupling, load sharing and changing over generators
1.3.2 Ability to couple and break connection between switchboards and distribution panels

1.4 OPERATE AND MAINTAIN POWER SYSTEMS IN EXCESS OF 1,000 VOLTS

1.4.1 Knowledge and understanding of high-voltage technology
1.4.2 Knowledge and understanding and appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts
1.4.3 Knowledge of safety precautions and procedures of high voltage equipment
1.4.4 Knowledge and understanding of high voltage electrical propulsion of the ships, electrical motors and control systems
1.4.5 Factual knowledge and skills in safe operation and maintenance of high voltage systems, including knowledge of the special technical type of high voltage systems

1.5 OPERATE COMPUTERS AND COMPUTER NETWORKS ON SHIPS

1.5.1 Knowledge and understanding of main principles and features of data processing
1.5.2 Knowledge and understanding of construction and use of computer networks on ships
1.5.3 Knowledge and understanding of construction and application features of bridge-based, engine-room-based and commercial computer systems
1.5.4 Ability to operate computers and computer networks on ships

1.6 USE ENGLISH IN WRITTEN AND ORAL FORM

1.6.1 Knowledge of the English language to enable the officer to use engineering publications and to perform the officer’s duties
1.6.2 Ability to communicate with peers and supervisors

1.7 USE INTERNAL COMMUNICATION SYSTEMS

1.7.1 Knowledge and understanding of construction and operation principles of different types of internal communication systems
1.7.2 Ability to operate of all internal communication systems on board

1.8 MONITOR THE OPERATION OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS

1.8.1 Knowledge of construction and operation principles of bridge navigation equipment and ship communication systems
1.8.2 Ability to appreciate condition of bridge navigation equipment and ship communication systems

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

1.1 MONITOR THE OPERATION OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS

1.1.1 States and explains basic laws and terms of electro-technology and applies them in compliance with object and situation
1.1.2 Demonstrates knowledge of electrical materials technology. Use electrical materials according to its intended purpose
1.1.3 Explains construction and operation of electrical machines. Understands basic laws and terms of electrical machines theory
1.1.4 Explains structure, operating principles and application of electronic and power electronic elements. Reads and draws electronic diagrams
1.1.5 Explains design specifics of various types of ships and propulsions
1.1.6 States basic laws and understands processes of heat transmission, mechanics and hydromechanics
1.1.7 Explains construction, purpose, operation and processes of mechanical engineering systems. Defines the condition of mechanical engineering systems on the basis of measured parameters
1.1.8 States and explains basic laws and terms of electrical drive theory. Shows ability to appreciate operation of electrical drives
1.1.9 Explains purpose, construction and operation of electrical power distribution boards and electrical equipment and defines its proper operation
1.1.10 States and explains basic laws and principles of automation, automatic control systems and technology. Defines quality of control process in accordance with performance criteria
1.1.11 Able to gather and interpret sensor and instrument readings for appreciation of equipment condition
1.1.12 Describes construction and operation of instrumentation, alarm and monitoring systems and correctly uses in monitoring process
1.1.13 Explains construction and operation of electro-hydraulic and electro-pneumatic control systems

1.2 MONITOR THE OPERATION OF AUTOMATIC CONTROL SYSTEMS OF PROPULSION AND AUXILIARY MACHINERY

1.2.1 Explains construction, operation principles and monitoring procedures of automatic control systems of propulsion and auxiliary machinery. Prepares control systems of propulsion and auxiliary machinery in accordance with the manuals and good practice
1.2.2 Demonstrates ability to survey main propulsion plant and auxiliary systems sufficiently to maintain safe operation condition
1.2.3 Explains construction and operating principles of Dynamic Positioning Systems

1.3 OPERATE GENERATORS AND DISTRIBUTION SYSTEMS

1.3.1 Explains procedures, plans and carries out coupling, load sharing and changing over generators in accordance with operating manuals, established rules and good practice
1.3.2 Demonstrates ability to couple, brake connection between switchboards and distribution panels in conformity to the safety rules and good practice

1.4 OPERATE AND MAINTAIN POWER SYSTEMS IN EXCESS OF 1,000 VOLTS

1.4.1 States basic terms of high voltage technology
1.4.2 Appreciates and defines hazards and precautions required for the operation of power systems above 1,000 volts
1.4.3 States safety precautions and procedures of high voltage equipment
1.4.4 Explains construction and operation of high voltage electrical propulsion of the ships, electrical motors and control systems
1.4.5 Carries out operation and maintenance procedures of high voltage systems, including special technical type of high voltage systems in accordance with operating manuals, established rules and good practice

1.5 OPERATE COMPUTERS AND COMPUTER NETWORKS ON SHIPS

1.5.1 States main principles and features of data processing
1.5.2 Explains construction and use of computer networks on ships
1.5.3 Describes construction and application features of bridge-based, engine-room based and commercial computer systems
1.5.4 Demonstrates ability to check and handle computer networks and computers

1.6 USE ENGLISH IN WRITTEN AND ORAL FORM

1.6.1 English language publications relevant to the officer’s duties are correctly interpreted
1.6.2 Demonstrates ability to hold up dialog by radio with peers and supervisors

1.7 USE INTERNAL COMMUNICATION SYSTEMS

1.7.1 Describes basic types and operation principles of communication systems
1.7.2 Transmits and receives of messages consistently successful. Communication records are complete, accurate and comply with statutory requirements

1.8 MONITOR THE OPERATION OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS

1.8.1 Describes construction and explains operation principles of bridge navigation equipment and ship communication systems
1.8.2 Lists important parameters and appreciates condition of bridge navigation equipment and ship communication systems

1.2.2 Function: Maintenance and Repair

- **Specification of competences**

2.1 MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC EQUIPMENT
2.2 MAINTENANCE AND REPAIR OF AUTOMATION AND CONTROL SYSTEMS OF MAIN PROPULSION AND AUXILIARY MACHINERY
2.3 MAINTENANCE AND REPAIR OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS
2.4 MAINTENANCE AND REPAIR OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS OF DECK MACHINERY AND CARGO HANDLING EQUIPMENT
2.5 MAINTENANCE AND REPAIR OF CONTROL AND SAFETY SYSTEMS OF HOTEL EQUIPMENT
2.6 USE SHIPS COMPUTER-BASED MAINTENANCE PLANNING SYSTEMS

- **Expected learning outcomes**

2.1 MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC EQUIPMENT

2.1.1 Ability to interpret electrical and electronic diagrams and use them for maintenance and repair
2.1.2 Knowledge of typical detection procedures of electric malfunctions and location of faults
2.1.3 Knowledge of construction, operation principles and features of electrical testing and measuring equipment and instruments
2.1.4 Knowledge of the typical maintenance and repair procedures of electrical and electronic equipment, communication systems, different kinds of control systems and appropriate practical experience
2.1.5 Ability to evaluate condition of electrical and electronic equipment
2.1.6 Ability to adjust different types of electrical, electronic and control equipment
2.1.7 Ability to provide function test of electrical, electronic control equipment and safety devices

2.2 MAINTENANCE AND REPAIR OF AUTOMATION AND CONTROL SYSTEMS OF MAIN PROPULSION AND AUXILIARY MACHINERY

2.2.1 Knowledge and understanding of safety requirements during maintenance and repair procedure of main propulsion and auxiliary machinery
2.2.2 Knowledge of operational regulations during maintenance and repair procedures of main propulsion and auxiliary machinery
2.2.3 Knowledge and understanding the principle of operation of main propulsion and auxiliary machinery automation and control systems
2.2.4 Ability to interpret diagrams of automation and control systems of main propulsion and auxiliary machinery
2.2.5 Ability to evaluate condition of automation and control systems of main propulsion and auxiliary machinery
2.2.6 Ability to find malfunction in automation and control systems of main propulsion and auxiliary machinery
2.2.7 Ability to adjust automation and control systems of main propulsion and auxiliary machinery

2.3 MAINTENANCE AND REPAIR OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS

2.3.1 Knowledge and understanding of safety requirements during maintenance and repair procedure of bridge navigation equipment and ship communication systems
2.3.2 Knowledge of operational regulations during maintenance and repair procedure of bridge navigation equipment and ship communication systems
2.3.3 Knowledge and understanding the general principle of operation of bridge navigation equipment and ship communication systems
2.3.4 Ability to interpret diagrams of bridge navigation equipment and ship communication systems
2.3.5 Ability to evaluate condition of bridge navigation equipment and ship communication systems
2.3.6 Ability to find malfunction in bridge navigation equipment and ship communication systems
2.3.7 Ability to adjust bridge navigation equipment and ship communication systems

2.4 MAINTENANCE AND REPAIR OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS OF DECK MACHINERY AND CARGO HANDLING EQUIPMENT

2.4.1 Knowledge and understanding of safety requirements during maintenance and repair procedure of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.2 Knowledge of operational regulations during maintenance and repair procedure of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.3 Knowledge and understanding the principle of operation of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.4 Knowledge and understanding the principle of explosion-proof protection of electrical, electronic and control systems of deck machinery and cargo-handling equipment
2.4.5 Ability to interpret diagrams of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.6 Ability to evaluate condition of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.7 Ability to find malfunction in electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.8 Ability to adjust electrical, electronic and control systems of deck machinery and cargo handling equipment

2.5 MAINTENANCE AND REPAIR OF CONTROL AND SAFETY SYSTEMS OF HOTEL EQUIPMENT

2.5.1 Knowledge and understanding of safety requirements during maintenance and repair procedure of hotel equipment
2.5.2 Knowledge of operational regulations during maintenance and repair procedure of hotel equipment
2.5.3 Knowledge and understanding the principle of operation of electrical, electronic and control systems of hotel equipment
2.5.4 Ability to interpret diagrams of electrical, electronic and control systems of hotel equipment
2.5.5 Ability to evaluate condition of electrical, electronic and control systems of hotel equipment
2.5.6 Ability to find malfunction in electrical, electronic and control systems of hotel equipment
2.5.7 Ability to adjust electrical, electronic and control systems of hotel equipment

2.6 USE SHIPS COMPUTER-BASED MAINTENANCE PLANNING SYSTEMS

2.6.1 Knowledge of basic operation principles of computer-based maintenance planning systems

2.6.2 Ability to use computer-based maintenance planning systems in accordance with users' guidance

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

2.1 MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC EQUIPMENT

2.1.1 Demonstrates ability to interpret electrical and electronic diagrams, block diagrams and electrical circuits
2.1.2 Demonstrates ability to use typical procedures of detecting electric malfunctions and location of faults
2.1.3 Explains operation principles and features of electrical testing and measuring equipment and instruments and their construction
2.1.4 Demonstrates ability to use typical maintenance and repair procedures of electrical and electronic equipment, communication systems, different kinds of control systems
2.1.5 Demonstrates ability to evaluate condition of electrical and electronic equipment
2.1.6 Demonstrates ability to adjust different types of electrical, electronic and control equipment
2.1.7 Demonstrates correct performance of testing of electrical, electronic control equipment and safety devices based on technical documentation and maker's manuals

2.2 MAINTENANCE AND REPAIR OF AUTOMATION AND CONTROL SYSTEMS OF MAIN PROPULSION AND AUXILIARY MACHINERY

2.2.1 Demonstrates ability to maintain safely and repair the main propulsion and auxiliary machinery
2.2.2 Explains main propulsion and auxiliary machinery control systems operational regulations and maintenance features
2.2.3 Recounts and explains the principle of operation of main propulsion and auxiliary automation and control systems
2.2.4 Demonstrates ability to interpret diagrams of automation and control systems of main propulsion and auxiliary machinery
2.2.5 Demonstrates ability to evaluate condition of automation and control systems of main propulsion and auxiliary machinery
2.2.6 Demonstrates ability to find malfunction in automation and control systems of main propulsion and auxiliary machinery
2.2.7 Demonstrates ability to adjust automation and control systems of main propulsion and auxiliary machinery

2.3 MAINTENANCE AND REPAIR OF BRIDGE NAVIGATION EQUIPMENT AND SHIP COMMUNICATION SYSTEMS

2.3.1 Demonstrates ability to maintain safely and repair the bridge navigation equipment and ship communication systems
2.3.2 Explains the bridge navigation equipment and ship communication systems operational regulations and maintenance features
2.3.3 Recounts and explains the general principle of operation of bridge navigation equipment and ship communication systems
2.3.4 Demonstrates ability to interpret diagrams of bridge navigation equipment and ship communication systems

2.3.5 Demonstrates ability to evaluate condition of bridge navigation equipment and ship communication systems
2.3.6 Demonstrates ability to find malfunction in bridge navigation equipment and ship communication systems
2.3.7 Demonstrates ability to adjust bridge navigation equipment and ship communication systems

2.4 MAINTENANCE AND REPAIR OF ELECTRICAL, ELECTRONIC AND CONTROL SYSTEMS OF DECK MACHINERY AND CARGO HANDLING EQUIPMENT

2.4.1 Demonstrates ability to maintain safely and repair the electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.2 Explains the electrical, electronic and control systems of deck machinery and cargo handling equipment operational regulations and maintenance features
2.4.3 Recounts and explains the principle of operation of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.4 Recounts and explains the principle of different types explosion-proof protection of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.5 Demonstrates ability to interpret diagrams of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.6 Demonstrates ability to evaluate condition of electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.7 Demonstrates ability to find malfunction in electrical, electronic and control systems of deck machinery and cargo handling equipment
2.4.8 Demonstrates ability to adjust electrical, electronic and control systems of deck machinery and cargo handling equipment

2.5 MAINTENANCE AND REPAIR OF CONTROL AND SAFETY SYSTEMS OF HOTEL EQUIPMENT

2.5.1 Demonstrates ability to maintain safely and repair the control and safety systems of hotel equipment
2.5.2 Explains the control and safety systems of hotel equipment operational regulations and maintenance features
2.5.3 Recounts and explains the principle of operation of control and safety systems of hotel equipment
2.5.4 Demonstrates ability to interpret diagrams of electrical, electronic and control systems of hotel equipment
2.5.5 Demonstrates ability to evaluate condition of electrical, electronic and control systems of hotel equipment
2.5.6 Demonstrates ability to find malfunction in electrical, electronic and control systems of hotel equipment
2.5.7 Demonstrates ability to adjust electrical, electronic and control systems of hotel equipment

2.6 USE SHIPS COMPUTER-BASED MAINTENANCE PLANNING SYSTEMS

2.6.1 Explains operation principles of computer-based maintenance planning systems
2.6.2 Demonstrates ability to use different types of ships computer-based maintenance planning systems in accordance with training tasks

1.2.3 Function: Controlling the Operation of the Ship and Care for Persons on Board

- **Specification of competences**

3.1 ENSURE COMPLIANCE WITH POLLUTION PREVENTION REQUIREMENTS
3.2 PREVENT, CONTROL AND FIGHT FIRE ON BOARD
3.3 OPERATE LIFE-SAVING APPLIANCES
3.4 APPLY MEDICAL FIRST AID ON BOARD SHIP
3.5 APPLICATION OF LEADERSHIP AND TEAMWORKING SKILLS
3.6 CONTRIBUTE TO THE SAFETY OF PERSONNEL AND SHIP
3.7 MAINTAIN THE OPERATIONAL CONDITION OF ELECTRICAL EQUIPMENT OF THE LIFE-SAVING AND OTHER SAFETY SYSTEMS

- **Expected learning outcomes**

3.1 ENSURE COMPLIANCE WITH POLLUTION PREVENTION REQUIREMENTS

3.1.1 Knowledge and understanding of the importance of active measures to protect the marine environment
3.1.2 Knowledge of the precautions to be taken to prevent pollution of the marine environment
3.1.3 Ability to apply the anti-pollution procedures and associated equipment

3.2 PREVENT, CONTROL AND FIGHT FIRE ON BOARD

3.2.1 Knowledge and understanding the precautions to be taken to prevent fire on board
3.2.2 Knowledge of classes and chemistry of fire
3.2.3 Knowledge of fire-fighting systems and equipment
3.2.4 Knowledge and understanding of the action to be taken in the event of fire, including fires involving oil systems
3.2.5 Ability to organize fire alarm

3.3 OPERATE LIFE-SAVING APPLIANCES

3.3.1 Knowledge of types and operation principles of the survival craft, rescue boats and their launching equipment
3.3.2 Ability to manage survivors and survival craft during and after abandoning ship
3.3.3 Ability to use the survival craft and rescue boats life-saving appliances including radio communication, satellite EPIRBs, SARTs, immersion suits and thermal protective aids
3.3.4 Ability to organize abandon ship alarm

3.4 APPLY MEDICAL FIRST AID ON BOARD SHIP

3.4.1 Knowledge of the basis of medical care
3.4.2 Ability to apply effective immediate first aid in the event of accident or illness on board and provide medical care to the injured and sick while they remain on board
3.4.3 Ability to participate in coordinated schemes for medical assistance to ships

3.5 APPLICATION OF LEADERSHIP AND TEAMWORKING SKILLS

3.5.1 Ability to communicate effectively about professional activities, problems and solutions with ratings, officers and supervisors

3.5.2 Knowledge and ability to apply decision-making methods
3.5.3 Ability to plan and structure work process and instruct others
3.5.4 Ability to manage resources and small groups of personnel
3.5.5 Ability to assess own work and subordinates and to assume the measures to improve its performance

3.6 CONTRIBUTE TO THE SAFETY OF PERSONNEL AND SHIP

3.6.1 Knowledge of the personal survival techniques
3.6.2 Knowledge of the fire prevention and ability to fight and extinguish fires
3.6.3 Knowledge of the elementary first aid
3.6.4 Knowledge of the personal safety and social responsibilities

3.7 MAINTAIN THE OPERATIONAL CONDITION OF ELECTRICAL EQUIPMENT OF THE LIFE-SAVING AND OTHER SAFETY SYSTEMS

3.7.1 Knowledge of assignment, construction, operation principles and important parameters of typical electrical equipment of the life-saving and safety systems
3.7.2 Ability to evaluate condition of electrical equipment of the life-saving and safety systems
3.7.3 Ability to maintain electrical equipment of the life-saving and safety systems in accordance with guidance

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

3.1 ENSURE COMPLIANCE WITH POLLUTION PREVENTION REQUIREMENTS

3.1.1 Explains importance of procedures for monitoring shipboard operations and ensuring compliance with pollution-prevention requirements are fully observed
3.1.2 Describes the anti-pollution procedures for prevention of marine environment pollution
3.1.3 Demonstrates skills to use the equipment necessary for storage and utilization of oil-containing liquids and sludge and anti-pollution equipment

3.2 PREVENT, CONTROL AND FIGHT FIRE ON BOARD

3.2.1 Describes the precautions for prevention fire on board
3.2.2 Demonstrates ability to assess the class of fire and to determinate the chemistry of fire
3.2.3 Demonstrates skills of using fire-fighting equipment and extinguishing methods, describes the fire-fighting systems
3.2.4 Describes the actions to be taken in the event of different types of fire

3.3 OPERATE LIFE-SAVING APPLIANCES

3.3.1 Demonstrates ability to:
- use different types of launch equipment
- operate the survival craft and rescue boats

3.3.2 Explains and demonstrates the actions to be taken for manage survivors and survival craft and rescue boats during and after abandoning ship
3.3.3 Demonstrates ability to use:

- survival craft and rescue boats equipment
- radio life-saving equipment, satellite EPIRBs, SARTs
- immersion suits
- thermal protective aids

3.4 PROVIDE MEDICAL CARE TO THE SICK AND INJURED WHILE THEY REMAIN ON BOARD

3.4.1 Explains the basic concept of first aid, medical treatment, and use medicine
3.4.2 Demonstrates skills to making examination of casualty or patient and apply first aid and medical care in case of accident or illness on board
3.4.3 Demonstrates skills to provide medical treatment and care fore the sick and injured crewmembers
3.4.4 Demonstrate ability to:
- use of the Medical First Aid Guide
- use external assistance

3.5 APPLICATION OF LEADERSHIP AND TEAMWORKING SKILLS

3.5.1 Demonstrates ability to communicate with ratings, officers and supervisors regarding professional activities, explain the goals and expected standards of work to the crew
3.5.2 Demonstrates ability to make most effective decisions for the situations
3.5.3 Demonstrates ability to plan operations and allocate resources for well perform necessary tasks
3.5.4 Demonstrates the effective leadership behaviours
3.5.5 Explains the methods of assess of the own work and subordinated and their improvement ways

3.6 CONTRIBUTE TO THE SAFETY OF PERSONNEL AND SHIP

3.6.1 Describes the types of emergency situations which may occur, such as:
- collision
- fire
- foundering

itemizes the life-saving appliances normally carried on ships; describes the location of personal life-saving appliances; demonstrates the skills of use personal and group life-saving equipment
3.6.2 Describes the shipboard fire-fighting organization. Demonstrates the locations of fire-fighting appliances and emergency escape routes. Explain elements of fire and explosion (the fire triangle). Demonstrates of using fire-fighting equipment
3.6.3 Explains the reasons of casualties and threats to own safety to make appreciation of hull structure and functions
3.6.4 Understands personal safety and social responsibilities importance and explains their procedures

3.7 MAINTAIN THE OPERATIONAL CONDITION OF ELECTRICAL EQUIPMENT OF THE LIFE-SAVING AND OTHER SAFETY SYSTEMS

3.7.1 Explains the assignment, construction, operation principles and important parameters of typical electrical equipment of the life-saving and safety systems
3.7.2 Demonstrates ability to evaluate condition of electrical equipment of the life-saving and safety systems
3.7.3 Demonstrates ability to maintain electrical equipment of the life-saving and safety systems in accordance with guidance

1.3 Teaching syllabus

1.3.1 List of subjects and students'/trainees' workload

№	Subject	References to expected learning outcomes	Workload hours
S.1.1	Electro-technology	1.1.1	150
S.1.2	Electrical materials technology	1.1.2	30
S.1.3	Electrical machines and electrical drives	1.1.3, 1.1.8	120
S.1.4	Electronics and power electronics	1.1.4	90
S.1.5	Ships design and propulsion	1.1.5	60
S.1.6	Basics of mechanical engineering	1.1.6	60
S.1.7	Mechanical engineering systems	1.1.7	90
S.1.8	Ships electrical power plants	1.1.9, 1.3.1, 1.3.2	120
S.1.9	Automation control theory	1.1.10	90
S.1.10	Ships propulsion and auxiliary machinery control systems	1.1.10, 1.1.13, 1.2.1, 1.2.2	90
S.1.11	Operation and maintenance of electrical equipment in ships hazardous areas	2.4.4	30
S.1.12	Ships instrumentation in monitoring and control	1.1.11, 1.1.12	60
S.1.13	Operation and maintenance of high voltage equipment	1.4.1-1.4.5	60
S.1.14	Ships computer systems and data processing	1.5.1, 1.5.3, 1.5.4	90
S.1.15	Bridge navigation equipment and Dynamic Positioning Systems	1.2.3, 1.8.1, 1.8.2	90
S.1.16	Ships computer networks	1.5.2, 1.5.4	60
S.1.17	English language	1.6.1	90

№	Subject	References to expected learning outcomes	Workload hours
S.1.18	Ships communication systems	1.7.1, 1.7.2, 1.8.1, 1.8.2	60
S.1.19	Fault detection procedures	2.1.1, 2.1.2	30
S.1.20	Electrical instruments, testing and measuring equipment	2.1.3	30
S.1.21	Maintenance and repair technique	2.1.4 - 2.1.7, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.5.1, 2.5.2	60
S.1.22	Maintenance and repair of electronic equipment and control systems	2.2.3 - 2.2.7, 2.3.3 - 2.3.7, 2.4.3 - 2.4.8, 2.5.3 - 2.5.7, 2.6.1, 2.6.2	30
S.1.23	Maintenance and repair of power electrical equipment	2.1.5, 2.1.6, 2.4.4 - 2.4.8, 2.6.1, 2.6.2	30
S.1.24	Marine pollution prevention, MARPOL	3.1.1 - 3.1.3	30
S.1.25	Fire prevention and fighting procedures	3.2.1 - 3.2.5	30
S.1.26	Life-saving appliances and surviving technic in emergency situations	3.3.1 - 3.3.4, 3.7.1 - 3.7.3	30
S.1.27	Basic medical aid assistance	3.4.1 - 3.4.3	30
S.1.28	Teamworking and leadership	3.5.1 - 3.5.5	30
S.1.29	Safety of personnel and ship	3.6.1 - 3.6.4	30
Total hours			1800

Workload indicates the time that student (trainee) typically need to complete all learning activities required to achieve the expected learning outcomes. Workload embraces the time spent on independent work, compulsory work placements, preparation for assessment and the time necessary for the assessment. It includes hours for lectures, laboratory and practical works, workshops, seminars, individual tasks and projects, self-study and examinations.

The proposed course timetable is based on modular principle with standardized size of all course components. Each subject (module) has the same value (30 hours) or multiples of it (e.g. 60, 90, …). Presented number of hours is approximate and can be corrected depending on accepted teaching methodology, available teaching facilities and equipment and level of students' (trainees') readiness.
Educational (training) institution should define workloads for different types of learning activities. It is important to take into account need of the students (trainees) independent work as for performance of individual tasks, self-study, and preparation for examinations and for preparation for contact hours. It has to be taken into account that different types of learning activities can require different volume of independent work. So, laboratory work and lecture may require the same number of contact hours, but one may require significantly greater workload than the other because of differing amounts of independent preparation by students (trainees).
The estimation of workload should be periodically refined through monitoring and students (trainees) feedback.

1.3.2 Description of subjects

S.1.1 Electro-technology

The study in this subject provides the basic knowledge of:

- basic concepts: current, voltage, resistance, electrical conductance, capacity, induction, electrical power and energy
- direct current circuits, Ohm's Law, series and parallel circuits
- Kirchhoff's Law, methods of electrical circuits calculation
- Faraday's Law, Lenz's Law
- non-linear direct current circuits
- alternate current circuits, sine wave current, vector diagrams RL, RC and RLC circuits
- series and parallel connection of RL, RC and RLC circuits, currents' resonance, voltages' resonance, circuits calculation using complex numbers method
- active and passive dipoles, quadripoles
- electrical filters
- three-phase circuits, phase and linear voltage, phase diagrams, calculation of star – triangle systems
- active and reactive power, total power, power factor in one and three-phase circuits, calculation methods
- non-sine wave circuits, highest harmonics in three-phase circuits
- non-linear alternate current circuits
- transient and commutation Laws, work of RL, RC and RLC circuits in transitive mode, calculation methods
- magnetism and electromagnetic induction, Ampere's Law
- magnetic circuits, electromagnetic field, electrostatic field, electrical field, magnetic field
- self and mutual induction
- circuits with the allocated parameters
- electrical circuits diagnostics

S.1.2 Electrical materials technology

The study in this subject provides the basic knowledge of:

- electro technical materials: classification, physicochemical properties, energy spectrum of electrons and materials class fission
- conductors and conducting materials, properties and quantitative adjectives of conductors
- application of conducting materials
- dielectric physics: dielectric polarization, electrical conduction in dielectric, dielectric constant, dielectric break-down
- dielectric materials: classification and applications in electrical engineering
- physical characteristics of various plastics, their thermal properties and applications on shipboard
- semiconductors: proper and extrinsic semiconductors, electrical conductivity and photoconductivity of semiconductors, electrical conductivity in high-field
- semiconductor materials, production and key specifications
- superconducting materials, its general properties, classification and applications on-board
- magnetic materials: magnetism and magnetic properties of materials
- magnetization process and quantitative variables of magnetic materials
- magnetic materials, its properties and applications in marine engineering

- criteria of selection of proper material for given application
- influence of marine environment on electrical materials durability
- future development in technology of electrical materials for marine applications

S.1.3 Electrical machines and electrical drives

The study in this subject provides the basic knowledge of:

- electrical machines theory: electromechanical energy conversion, basic physical laws (Faraday's law and Lenz's law), convertibility of electrical machines, electrical machine windings, electromotive force and magneto motive force of windings, magnetic fields and leakage reactance of electrical machine windings, magnetic circuit calculations, energy loss, efficiency output, heating and cooling of the electrical machines
- fundamentals of electrical machines: classification, typical designs, operation principles of various machines
- particular features of electrical machines for marine applications and rules of their design, including high voltage machines (above 1,000 V)
- marine applications of electrical machines
- transformers: one and three-phase transformers; equivalent circuit of replacement and phase diagram of the transformer; groups of winding connection in three-phase transformers; parallel work of transformers
- direct current (DC) machines: operation principle of DC generator and motor; commutator and brush devices, excitation winding; shunt, series and compound DC motors; start-up and speed adjustment methods of DC motors
- asynchronous machines: basic construction, rotating field, slip and torque; operation principle of alternate current (AC) induction motor; equivalent circuit and phase diagram of induction motor; electrical and mechanical performance; start-up and speed adjustment methods of induction motors; AC induction generator performance; efficiency and power factor control and energy optimization of electric motors; rating of AC induction motors; electric motor duty cycles; cooling and ventilation of electric motors; construction and mounting of AC induction motors; motor selection
- synchronous machines: operation principle and construction of synchronous machine; equivalent circuit and phase diagram of synchronous generator; operation of synchronous machine as the motor
- special machines: construction and operation principle of commutator motors; single-phase motors
- permanent-magnet AC machines
- electrical drive theory: mechanical characteristics of drivers, start-up methods, commutation and protective devices, control principles of parameters, logical control system of drivers, control system of regulated drives, electrical drivers energy characteristics, steady-state analysis of closed-loop systems
- DC motor drives: thyristor DC drives, control arrangement for DC drives, DC servo drives, digitally controlled DC drives
- variable frequency inverter-fed induction motor drives: motor drives, voltage source inverters (VSI) and current source inverters (CSI); control arrangements for inverter-fed drives; open-loop speed control, closed-loop speed control, vector or field-oriented control; torque–speed characteristics and V/f control
- cycloconverter drives
- stepping motors: principle of motor operation, drive circuits
- synchronous, brushless DC and switched reluctance drives: controlled-speed synchronous motor drives, switched reluctance motor drives

- electrical drives of engine room auxiliary machinery, deck and cargo handling equipment: basic parameters and characteristics of the ship's electric drives and control systems, the rules for determining of control algorithms of the ship automated electric drives; elements of the circuits and typical devices of automation systems with electric drives
- electrical propulsion machines and drives: HV transformers (air cooled and liquid cooled) with protections; types of electric motors, excitations, motor cooling; frequency controlled drives used in main propulsion systems; methods of electric motor control used in propulsion drives; remote control systems of podded propulsors

S.1.4 Electronics and power electronics

The study in this subject provides the basic knowledge of:

- fundamentals of analog and digital electronics and microcircuitry: basic elements (Si and Ge-diodes, bipolar transistors, Darlington pair, MOS transistors); voltage-current and output characteristics; equivalent circuits
- bipolar transistors basic diagrams, signal amplifiers, current sources on bipolar transistor, differential amplifiers
- MOS transistor amplifiers, basic diagrams, current sources on MOS transistor, differential amplifiers
- operational amplifiers: characteristics, frequency correction, comparators, operational amplifier diagrams
- active filters: filters of low and high frequency, band filters
- generators (oscillators): RC, LC, quartz oscillators, multivibrators
- power amplifiers: emitter followers, pulse power amplifiers
- digital electronics: logic algebra, logical variables, logical operations, logic circuitry analysis, combinational circuits construction
- electronic realization of logical circuits: transistor-transistor logic (TTL), CMOS-technology circuits, decoders, multiplexers, demultiplexers, triggers, registers, counters, memory devices
- power sources: rectification and filtration, rectification circuits, stabilization of analog voltage, switch-mode power supplies(SMPS)
- power semiconductors: basic operating principals, power electronic switches, switching performance (current, voltage), control and protective circuits, power module integration levels
- fundamentals of power electronics (basic elements)
- rectifier diodes: general terms, structure and functional principle (pn-diodes, Schottky diodes), static and dynamic behaviours, application
- thyristors: general terms, structure and functional principle (pn-diodes, Schottky diodes), static and dynamic behaviours, application
- Integrated Gate Commutated Thyristor (IGCT) - structure and functional principle, static and dynamic behaviours, application
- freewheeling and snubber diodes: structure and functional principle, static and dynamic behaviours, application
- power MOSFET and IGBT: structure and functional principle, static and switching behaviours, assembly and connection technology; power modules with integrated sensors, protective equipment and driver electronics; application
- drivers for power basic elements: gate current and gate voltage characteristics, driver parameters and switching properties, driver circuit structures, protection and monitoring functions, transmission of driver signal, types of faults/errors and fault detection

- starting and speed control of D.C. and A.C. motors, using power electronic converters: construction and operation principle of controlled rectifier, current and voltage source inverters, cycloconverters
- power electronic converters used in ships' electrical propulsion
- diagnostics and testing methods of semi-conductor devices and circuits

S.1.5 Ships design and propulsion

The study in this subject provides the basic knowledge of:

- ships classification
- design specifics of different ship types
- ship's hull nomenclature, structural arrangement, main dimensions and tonnages
- basic regulations and classification societies requirements on ships construction
- on-board plans and drawings
- forces, stresses and stiffening of a ship hull
- ships equipment arrangement, purpose and location
- ships propulsion plants classification
- design specifics of propulsion plants
- types, configuration and efficiency of propulsion plants
- design specifics and forces of rudders
- ship propellers and propulsors: fixed pitch propellers, controllable pitch propellers, nozzles, rudder propellers, water-jets, azimuth thrusters, podded propulsors
- propulsion transmission systems
- ship general systems: fire system, bilge system, ballast system, fresh water system, sanitary water system, air conditioning system, refrigeration system, ventilation system, heating system

S.1.6 Basics of mechanical engineering

The study in this subject provides the basic knowledge of:

- heat transfer terminology
- conduction heat transfer
- convection heat transfer
- radiant heat transfer
- heat exchangers
- boiling heat transfer
- heat generation
- statics
- mechanical system
- force system
- kinematics
- strength of materials
- mating of components
- shafts, axles and clutches
- permanent and threaded connections
- scalar and vector quantities
- graphical representation of force
- resultants
- moment of force
- equilibrium

- mass and volume
- speed and acceleration
- forms of energy, work and power
- pressure, depth of liquid and force
- thermodynamic properties
- temperature and pressure measurements
- thermodynamic systems and processes
- property diagrams
- first law of thermodynamics
- second law of thermodynamics
- compression processes
- continuity equation
- laminar and turbulent flow
- Bernoulli's equation
- head loss

S.1.7 Mechanical engineering systems

The study in this subject provides the basic knowledge of:

- engine room and ship piping systems
- construction and operation of ship main engines: diesel engines, steam and gas turbines, steam boilers
- static modes and characteristics of ships' main engines
- construction and operation of ship auxiliary machinery including among others: pumps, valves, filters, pipelines, compressors, fans, purifiers, heat exchangers, pneumatic and hydraulic systems, cleaning machinery, steering gear, shafts, bow thrusters and stabilizers
- construction and operation of steering gears, rudder propellers, podded propulsors and cycloid propulsors
- construction and operation of cargo handling machinery of general cargo ships, containers, tankers, (Inert Gas System), LNG carriers and chemical carriers
- construction and operation of cargo winches, deck cranes, capstans, mooring winches, windlass, hatch cowers and watertight door
- construction and operation of ships hotel equipment

S.1.8 Ships electrical power plants

The study in this subject provides the basic knowledge of:

- ship's electrical power sources: generators, batteries, converters
- ship's electrical power plant one line diagrams
- main and emergency electrical power plants
- different voltages on board
- fundamentals of electrical distribution systems
- power distribution boards
- switching and protection equipment used in power distribution systems
- cables: marine cables and wires, cable marks and identification system, cross-section of cables considering long-period current tolerance and acceptable voltage drop, basic rules of cable arrangement, rules and purposes of cable shielding
- lighting fixtures and other marine electrical devices
- switchboard insulation measuring device

- rules of the parallel working of generators
- methods of the synchronization of the generators to the busbar
- generators voltage and frequency control systems
- load sharing principles and devices
- generators excitation and safety systems
- principles of power management
- principles of starting of emergency generator
- power distribution systems of the electrical energy on the ships
- construction of main and emergency switchboards
- instruments used in synchronization process
- construction and the operation principle of circuit breakers and their trips
- rules of procedure after the black-out and connection between the main switchboard and emergency switchboard
- procedure of change-over to shore-connection supply

S.1.9 Automation control theory

The study in this subject provides the basic knowledge of:

- control systems classification
- principles of control systems arrangement
- methods of control systems description
- control systems functional diagrams
- sensing unit, controller, controlled variable, manipulating variable and controlled object
- control laws
- typical dynamic units
- transfer functions
- static, astatic and dynamic characteristics
- gain, time constant and offset
- control systems stability
- Boolean Algebra
- logical devices
- digital control systems
- Moore - automat and Mealy – automat
- Proportional-Integral-Derivative (PID) control
- ON-OFF control
- principles of sequence control
- principles and control functions of single controlled objects, groups of objects and hierarchical structures
- optimal control
- adaptive control systems

S.1.10 Ships propulsion and auxiliary machinery control systems

The study in this subject provides the basic knowledge of:

- control specifics of different types of ship propulsion
- functions and tasks of control systems of main propulsion and auxiliary machinery
- block diagrams of main propulsion control systems
- main propulsion control systems used in normal conditions and in emergency
- principle of propulsion control changeover in emergency (use of engine telegraph)

- safety systems of main propulsion
- electronic and electrical control systems operating parameters of the main propulsion
- speed control and reversing systems of main engine with fixed and variable pitch propeller
- procedures for prepare to: start main engine, clutch main engine, change over the main engine control, stop and prepare main engine for harbour condition
- Programmable Logic Controllers, Programmable Automatic Controllers, hydraulic and pneumatic controllers of main propulsion and auxiliary machinery
- automatic control systems and procedures for preparation and starting of air compressors
- automatic control systems of auxiliary boilers; steering gear; fuel oil, cooling and lubricating oil systems
- automatic control systems including fuel temperature and viscosity control and boiler starting and stopping procedures
- automatic control systems of FO and LO purifiers and procedures for starting and stopping of FO and LO purifiers
- sequential re-starting for auxiliary machinery
- cut-in arrangements for auxiliary of unmanned machinery space
- automatic control systems of provision and cargo refrigeration plant and their starting and stopping procedures
- automatic control systems of reefer containers
- automatic control systems of air conditioning plant and it's starting and stopping procedures for summer and winter conditions

S.1.11 Operation and maintenance of electrical equipment in ships hazardous areas

The study in this subject provides the basic knowledge of:

- nature of flammable materials
- gas, dust grouping
- temperature codes
- ingress protection
- recognizing of hazardous area (gas, dust)
- types of explosion-proof protection for electrical equipment, particularly:
  - flameproof Ex d
  - increased Safety Ex e
  - pressurization Ex p
  - intrinsic safety Ex i apparatus
- combined (hybrid) methods of protection
- wiring systems
- permit to work system and safe isolation
- operation and maintenance of electrical equipment in hazardous area
- IECEX versus ATEX and North America approach
- Ex certificates

S.1.12 Ships instrumentation in monitoring and control

The study in this subject provides the basic knowledge of:

- ways of gathering information
- methods of relevant data interpretation
- fundamentals of signal processing
- functions and typical diagrams of ships instrumentation and monitoring systems

- distributed monitoring and control systems for engine room and deck
- measurement and control lines in the distributed monitoring and control systems (temperature, pressure, level, salinity, voltage, current, frequency, etc.)
- sensors and transducers for nonelectrical values
- smart/intelligent transducers
- safety systems
- fire-detection systems, flame detection sensors, temperature detection sensors, smoke detection sensors
- watch keeping systems
- oil detector
- oil mist detection systems
- gas detector systems
- oxygen detector systems

S.1.13 Operation and maintenance of high voltage equipment

The study in this subject provides the basic knowledge of:

- hazards of electrical shock at the voltage above 1,000 volts
- effects of electric shock at the voltage above 1,000 volts
- operation procedures for electrical equipment above 1,000 volts
- electric arc effects at the voltage above 1,000 volts
- arrangement of high voltage substations/switchrooms
- operation and safety features of switchgear
- Safety Lockout Procedure, Key Safes/Multi Hasp locking device (Isolocks)
- practical switching exercises
- high voltage electrical protections
- treatment of the system neutral point
- ships high voltage (HV) systems: HV apparatus, cables, electrical machines, switchboards, fuses, etc.
- HV measurement and control equipment and apparatus
- operation principle of power management systems
- synchronisation and control of generators
- maintenance of HV equipment and apparatus
- HV electric propulsion configuration and components
- HV electric motors and frequency drives used in ship propulsion systems
- personal safety equipment for HV works
- testing equipment for HV works
- safety procedures for HV works

S.1.14 Ships computer systems and data processing

The study in this subject provides basic knowledge of:

- specific features of bridge based computer systems: Integrated Navigation Systems, bridge alarm systems fuel consumption optimizing system, load and hull - stress calculation systems, fire detection systems
- specific features of engine room based systems: PLC and PC for power management systems, fuel storage, transport and preparation, refrigeration systems, cargo and ballast systems
- commercial computers: ship correspondence and data exchange systems, vessel management systems (for example AMOS)

- programmable monitoring and control systems, Electronic Alarm Recorder, systems for critical equipment condition monitoring
- PC construction, buses, peripheral devices
- main features and operating principle of microprocessors
- data input-output in computer systems, interface circuits, matching devices
- analog-to-digital conversion, digital-to-analog conversion
- error protection
- data transferring methods
- software types: operating systems, application software
- data types and data description in digital systems
- typical data processing diagram
- numeral systems, binary codes
- computer or PLC work memory structure and access methods
- bit, byte and Word Data processing, logical functions, bit memory, time functions, counters, edges
- basics of programming methods, languages and algorithms
- typical computer programming instructions: logical instructions, move, shift and rotate instructions, for…next and if… else
- data storage features, operations on stored measurements, data storage devices
- PLC and PC program structures: subroutines, interrupts, sequential control relays
- combinatorial systems, minimizing of system logic functions, output functions, block diagrams of system functions
- sequential systems, transition functions, system states, the state variables and the output function
- digital PID control, controller parameters, interrupt processing of control loops
- data measurement and filtering, smoothing methods

S.1.15 Bridge navigation equipment and Dynamic Positioning Systems

The study in this subject provides basic knowledge of:

- construction and operation principles of bridge navigation systems and equipment:
  - autopilot control systems
  - Electronic Chart Display and Information System (ECDIS)
  - radars
  - Global Navigation Satellite Systems (GPS, GLONASS, Galileo)
  - gyro compasses
  - speed logs
  - echo sounder systems
  - voyage data recorder (VDR)
  - navigation lights
  - search lights
  - horns and sound signal systems
  - wind trackers
  - ship clock
  - inertial navigation systems
- construction and operation principles of dynamic positioning systems equipment:
  - human-machine interface
  - operator station functions, backup/restore, alarm system
  - dynamic positioning controllers, system interface, network
  - position reference systems

- environment reference systems and sensors
- heading reference systems
- thrusters and propulsion systems

S.1.16 Ships computer networks

The study in this subject provides basic knowledge of:

- Industrial networks in process control, their purpose and structures
- OSI/ISO Model, nodes functions and binary codes
- serial transmission of data bus, RS 232, RS 422, RS 485, cable connectors and terminators
- Internet and Ethernet protocols, OSI/ISO, TCP/IP
- medium access methods: master-slave, master-slave with cyclical polling, token ring, token ring with master-slave polling, CSMA/CD, CSMA/CA
- Profibus DP network, nodes, structures, objects of configuration, programming of data exchange
- Industrial Ethernet network, nodes, structures, configuration, data exchange configured objects: connections, transfers, calls the instructions, principles of data exchange programming
- USS network, Modbus network, their nodes, structures, configuration, data exchange
- fiber-optic networks and cables, characteristics of optical fibers and cables, light sources and detectors

S.1.17 English language

The study in this subject provides basic knowledge of:

- use English in written and oral form to:
  - perform the officer’s duties
  - use general maritime vocabulary
  - use marine technical terminology
  - read manufactures' manuals
  - use shipboard drawings
  - use other engineering publications

It is recommended to provide study of this subject using IMO Model Course 3.17 “Maritime English”

S.1.18 Ships communication and alarm systems

The study in this subject provides the basic knowledge of operation and skills to maintain the following ship communication and alarm systems:

- Automatic Telephone System
- Emergency Sound Powered Telephone System
- Talk Back System
- Public Address System
- UHF internal communication system
- basics of terrestrial and satellite communications
- digital selective calling (DSC) in VHF, MF/HF bands
- radiotelephony in VHF, MF/HF bands

- Radiotelex (Narrow Band Direct Printing, NBDP) in MF/HF band; Automatic ReQuest (ARQ) and Forward Error Correction (FEC) modes of telex communication
- communications for providing Maritime Safety Information (MSI); NAVTEX, EGC, HP MSI ship's installations
- VHF communication with aeronautical crafts in Search and Rescue SAR) operations
- radio installations of survival crafts; Emergency Position Indicating Radio Beacon (EPIRB), Search and Rescue Transponder (SART), VHF portable stations
- satellite ship stations (SES):
  - Inmarsat-B
  - Inmarsat-C
  - Inmarsat-M, mini-M
  - Fleet 77
- Ship Security Alert System (SSAS) and Long Range Identification and Tracking Systems (LRIT)
- satellite communication for general communication
- Bridge Navigational Watch Alarm System
- engine room alarm system
- Fire Detection and Control System
- Hospital Call System
- cold room trap alarm

S.1.19 Fault detection procedures

The study in this subject provides basic knowledge of:

- principles of maintenance and repair of different ship’s electrical equipment
- methods for detection of electrical failures, and use of measuring equipment for fault finding
- fault finding procedures using electrical wiring diagrams
- fault protection principles

It is recommended during study process to use diagrams and simulators of different types of electrical and electronic equipment

S.1.20 Electrical instruments, testing and measuring equipment

The study in this subject provides basic knowledge of:

- fundamental notions of metrology: measurement range, errors and uncertainty
- construction and operation principle of analogue and digital instruments for basic electrical values measurement, as voltage, current, frequency, power, insulation, time and phase displacement
- basic rules for using and connection of instruments to the electrical circuit for measurement of voltage, current, frequency and power
- instruments accuracy class and sensitivity
- oscilloscope and interpretation of the recorded results
- measurements before and after the running of the device in order to determine its condition
- practical way how to take measurement after damage and repair
- principles of interpretation of measurement results

S.1.21 Maintenance and repair technique

The study in this subject provides basic knowledge of:

- electrical and electronic systems reliability
- reliability indexes
- faults and malfunctions classification
- reliability improvement methods
- required spare parts defining
- evaluation and prediction of equipment condition
- principle of major and periodic overhaul, periodic maintenance, survey after damage with the use of technical documentation
- principle of organization of maintenance, repair and its documental description
- maintenance intervals, repairs and spare parts in the computer system (e.g. AMOS)

S.1.22 Maintenance and repair of electronic equipment and control systems

The study in this subject provides basic knowledge of:

- principle of controller optimal settings according to the Ziegler-Nichols rule and manual adjustment of controller according to observed control errors
- principles of maintenance and repair of:
  - propulsion remote control systems
  - fuel temperature and viscosity automatic control systems
  - compressed air automatic control system
  - lubrication, fuel and cooling automatic control systems
  - variable pitch propeller control systems
  - steam production automatic control systems
  - ship refrigeration plants control systems: provision, refrigerated cargo holds and containers, air condition
  - following engine auxiliary control systems: oil and fuel separators, sewage treatment plant, evaporator and osmotic fresh water generators, incinerators
  - steering gear control system
- principles of maintenance of bridge navigation systems and equipment:
  - autopilot control systems
  - Electronic Chart Display and Information System (ECDIS)
  - radars
  - global navigation satellite systems
  - gyro compasses
  - speed logs
  - echo sounder systems
  - voyage data recorder (VDR)
  - navigation lights
  - search lights
  - horns and sound signal systems
  - wind trackers
  - ship clock
  - internal navigation system
- principles of maintenance of communication systems:
  - various antenna types used in marine communication
  - Global Maritime Distress and Safety System (GMDSS)

- main and emergency power supply of ship communication systems
- Inmarsat Satellite Communication System
- Iridium Satellite Telephone System
- Automatic Identification System (AIS)
- Long Range Identification and Tracking System (LRIT)
- Ship Security Alert System (SSAS)

S.1.23 Maintenance and repair of power electrical equipment

The study in this subject provides basic knowledge of:

- principles of maintenance and repair of electrical machines
- principles of maintenance and repair of switchboards
- principles of maintenance and repair of commutating equipment
- principles of maintenance and repair of protection equipment
- principles of maintenance and repair of electrical, mechanical, pneumatic, hydraulic components and automation equipment of main propulsion, auxiliary machinery and deck cargo handling

S.1.24 Marine pollution prevention, MARPOL

The study in this subject provides basic knowledge of:

- structure and definitions of MARPOL 73/78
- types and consequences of marine pollutions
- antipollution procedures (MARPOL 73/78)
- antipollution equipment
- ways of elimination of marine pollutions

S.1.25 Fire prevention and fighting procedures

The study in this subject provides basic knowledge of:

- fire prevention procedures
- chemistry of fire
- firefighting systems and equipment
- firefighting procedures
- fire drills organizing

S.1.26 Lifesaving appliances and surviving technics in emergency situations

The study in this subject provides basic knowledge of:

- SOLAS – 74 requirements concerning life-saving appliances
- ships emergency signals
- abandon ship procedures
- individual life saving equipment and systems
- live saving technics
- abandon ship organizing

S.1.27 Basic medical aid assistance

The study in this subject provides basic knowledge of:

- basic medical knowledge
- application of medical guide and advance by radio
- first aid technics
- typical illnesses and accidents in maritime practice
- on board take care procedures

S.1.28 Teamworking and leadership

The study in this subject provides basic knowledge of:

- definition of term "Management"
- management activities:
  - planning
  - organizing and staffing
  - directing
  - controlling
- Maritime Labour Convention
- STCW Convention and Code concerning responsibilities of seafarers and shipping industries, and fitness for duties for working on shipboard tasks
- national legislations, its implementations referring to relevant regulations/recommendations
- decision-making technics:
  - decision making under certainty
  - decision making under risk
  - decision making under uncertainty

S.1.29 Safety of personnel and ship

The study in this subject provides basic knowledge of:

- subordination and social responsibility onboard
- providing general safety
- general provisions of ISM Code
- general provisions of ISPS Code
- personal safety
- personal survival technics
- elementary first aid

1.3.3 Assessment

Assessment enables the assessor (tutor) to ascertain if the student (trainee) has achieved the planned learning outcomes at a given point in a course or in working towards a qualification. Learning outcomes describe outcomes which are to be achieved by the student (trainee). It is important that student's (trainee's) achievements have to be measured objectively through an evaluation which will not be influenced by the personal opinions and judgements of the examiner. Objective evaluation provides a sound base on which to make reliable judgements concerning the levels of learning outcomes achieved, thus allowing an effective evaluation to be made of the progress of students (trainees) in a Course.

It is recommended to assess achieved learning outcomes and appropriate competencies by consecutive assessment of outcomes of each subject and comprehensive assessment at the end of the course.

It is recommended to assess learning outcomes of subject (module) trough one of the following methods:

- written examination;
- oral examination;
- tests;
- solution of practical tasks (including simulator-based exercises);
- laboratory reports;
- performance at a seminars and/or practical exercises (written or oral questions);
- assignments, activities, projects, tasks and/or case studies;
- records and reports of practical training.

It is possible to use a combination of two or more stated above methods for assessment of learning outcomes of one subject. As an example: laboratory reports or reports of practical exercises can be used for evaluation ability to execute or solve practical tasks and oral or written examination can be used for evaluation knowledge, understanding or cognitive skills.

The evaluation methods must be based on clearly defined objectives, and must truly represent what is meant to be assessed; e.g. against only the relevant criteria and the syllabus or course guide. It is important to select the assessment method most appropriate to the particular aspect of competence to be evaluated.

The assessors (tutors) need to know what they are to assess and then decide how to do this. The, what, will come from the expected learning outcomes of the subject / course they are delivering.

Assessment method or combination of assessment methods should be defined depending of method (methods) of demonstration of learning outcomes as recommended in sections «Demonstration of learning outcomes» in paragraphs 1.2.1; 1.2.2; 1.2.3 of this Course. In this regard the following methods are recommended for evaluation different kinds of Demonstrations of learning outcomes:

- states, explanations, demonstration of knowledge and so on can be assessed by both of performance at a practical exercises and seminars or oral examination or test;
- demonstration of cognitive skills should be assessed by written examination;
- demonstration of practical, manual skills and practical-oriented abilities can be assessed trough laboratory reports or practical exercises in classrooms or on simulators.

Assessment should also be reliable. Different groups of students (trainees) may have the same subject at different times. If other assessors are also assessing the same subject / course, there is need to ensure all are making the same decisions. To be reliable an evaluation procedure should produce reasonably consistent results, no matter which set of papers or version of the test is used.

For objectivity it is recommended to use more written examinations than oral. Examinations shouldn't be very long - no more than 2 - 3 hours.

It is recommended at examinations to avoid questions that require learning by rote only. The questions shall cover following aspects as minimum: knowledge; understanding; application of knowledge and understanding to solution of practical tasks.

Taking into account that different national educational and training systems have developed different approaches to grading which are deeply rooted in their pedagogical and cultural traditions, educational (training) institutions are recommended to keep track of their grading practice and culture, which is a good practice in many institutions.
However it is important that criteria of the successful Course / Course component completion have to be based on expected learning outcomes as mandatory requirements.

Part 2 Course for Senior Electro-Technical Officer

2.1 Course framework

- **Objectives**

This course aims to ensure professional-oriented specialized knowledge and understanding, cognitive and practical skills to support the competencies related to operating and maintaining specific ship's electrical and electronics equipment, complex systems; management of ship's electro-technical personnel and resources; management of complex activities related to electrical and electronics equipment.
This course is not linked directly to the standards of training that established in the STCW Code.
This course is principally intended for candidates for obtaining position of ship's senior electro-technical officer or similar. It is expected that graduates who completed this course successfully can be certified to appropriate rank in accordance with national requirements.
This course can not be regarded as tertiary programme directly. At the same time it is possible to implement this course as a part of university study programme leading to appropriate qualification (degree) of higher education.

- **Entry standards**

It is expected that entrants should complete the Course for Electro-Technical Officer before admission. Also it is expected that entrants will have achieved generic competencies which are peculiar for previous level of qualification and listed in chapter 1.1 "Course framework" of the Course for Electro-Technical Officer.
It is desirable that students (trainees) will have achieved certificate of competency in accordance with the regulation III/6 of the STCW Convention and seagoing service experience on position of electro-technical officer before admission. Fig. 2.1 illustrates the pathway of qualification and career development.
For entrants who will have completed ISCED level 3* or ISCED level 4* programme only before admission and won't have completed the Course for Electro-Technical Officer the combined study programme should be designed. Combined study programme should cover competencies for electro-technical officer and competencies of this course. The pathway of qualification and career development for this case is illustrated in the fig. 2.2.

- **Learning outcomes**

Learning outcomes describe what a student (trainee) is expected to know, understand and be able to do after successful completion of the learning (training) process. The few types of learning outcomes descriptions are used: General learning outcomes: Learning outcomes at the level of functions and competencies; Learning outcomes at the level of subject (module).
General learning outcomes describe the Course and Qualification as a whole. General learning outcomes of this Course are described in the section "Description of qualification".
Learning outcomes at the level of functions and competencies usually combine outcomes of one or few subjects. These learning outcomes are defined for each competence and presented in sections "Expected learning outcomes" in paragraphs 2.2.1, 2.2.2 and 2.2.3 of this Course.
Learning outcomes at the level of subject can contain the number of outcomes of different topics, exercises, etc. These learning outcomes shall be defined more detailed than at the level of functions and competencies. It is expected that learning outcomes of each subject shall be defined by educational (training) institution depending of accepted curriculum, descriptions of subjects and used facilities.
*) References to the International Standard Classification of Education – 2011

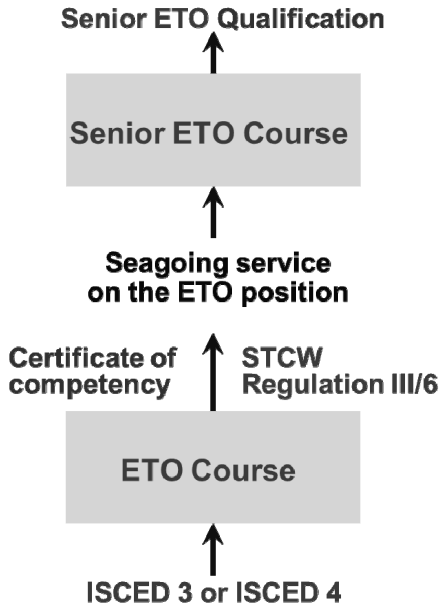


Fig. 2.1 Pathway of qualification and career development

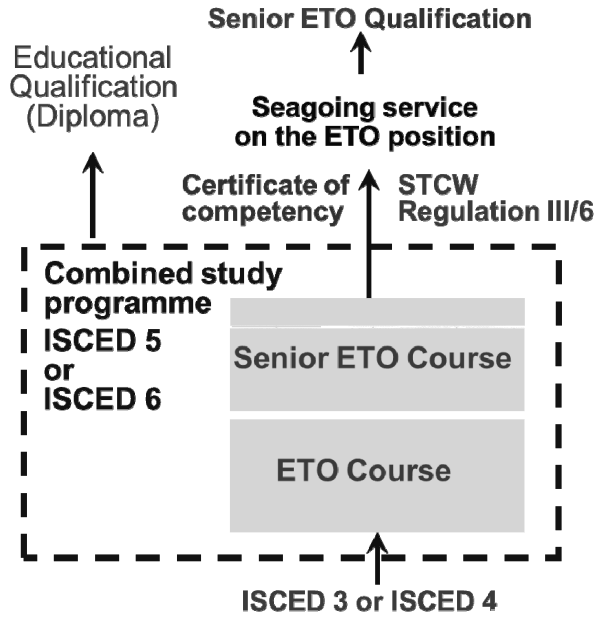


Fig. 2.2 Pathway of qualification and career development (combined study programme)

- **Description of qualification**

This course is oriented to give access to the profession with advanced skills and technical specification. It is envisaged that graduates who completed this course successfully will have direct labour market entry.
This course doesn't lead to qualification (degree) of tertiary education directly. At the same time it is acceptable to implement this course as a part of ISCED level 5* or ISCED level 6* study programme. In this case graduates can achieve appropriate educational qualification (degree).
Graduates should be capable to carry out duties of senior electro-technical officer or similar position related to operating, maintaining and repairing ship's electrical and electronic equipment, controlling the operation of the ship where advanced knowledge and management skills are necessary.
The qualification related to this course may be described by the following learning outcomes:

- Advanced and forefront knowledge in the field of marine electrical engineering, electronics and automation;
- Ability to gather and interpret relevant data to make judgments and to solve complex and unpredictable problems in the field of marine electrical engineering, electronics and automation;
- Ability to communicate about information, problems, judgments, ideas and solutions with supervisors, managers, peers and subordinated personnel;
- Ability to manage complex professional activities in the field of marine electrical engineering, electronics and automation;
- Ability to train shipboard personnel and to manage professional development of subordinated groups.

*) References to the International Standard Classification of Education – 2011

The qualification of senior electro-technical officer should be supported by the following generic competences:

- Ability to retrieve and analyze information from different sources;
- Capacity for analysis;
- Critical and self-critical abilities;
- Capacity to adapt to new situations;
- Problem solving and decision-making in unpredicted situations;
- Leadership;
- Ability to work in an interdisciplinary and international team;
- Initiatives.

- **Course requirements**

Study process must include contact hours and individual work. Individual work should include self-studying and carrying out individual tasks.
During self-studying students should learn theoretical material and prepare for workshops, laboratory and practical exercises, exams using textbooks and available facilities.
Lectures, workshops, laboratory and practical exercises should be provided in classrooms, laboratories and simulators. It is recommended to deliver lectures by professors or leading experts in corresponding subject.
During laboratory exercises students must carry out observations or experiments under the tutor supervising for proving theoretical statements.
When carrying out individual tasks (projects or tests) the student should individually solve theoretical or practical problems issued by a tutor. Individual tasks should be fulfilled autonomously with tutorial.
The subjects and content of individual tasks should be defined by educational / training institution depending on methodological and technical basis and on the level of study programme.
It is expected that course should be divided into a number of separated subjects or modules and learning outcomes of each of them should be assessed.
It is recommended that individual tasks required autonomous information search and analysis, choice of optimum methods of the decision, distribution of resources and team workload. This course should include the bigger volume of student's (trainee's) autonomous work than Course for ETO.
It is recommended to carry out comprehensive assessment at the end of the course. It is recommended to base this assessment on the summarizing individual project.

2.2 Course outline

This chapter is divided on three functions. Each of them is based on the list of professionally-oriented competencies.

2.2.1 Function: Electrical, Electronic and Control Engineering

- **Specification of competences**

1.1 SURVEY, ASSESS PERFORMANCE OF ELECTRICAL POWER GENERATION AND CONSUMPTION
1.2 SURVEY, ASSESS PERFORMANCE, PREDICT CONDITION AND ADJUST ALL ELECTRICAL, ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS
1.3 PLAN AND MANAGE COMPLEX ACTIVITIES TO PROVIDE CORRECT OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS
1.4 MANAGE SAFE OPERATION OF POWER SYSTEMS IN EXCESS OF 1,000 VOLTS
1.5 OPERATE ALL KINDS OF ELECTRICAL AND ELECTRONIC EQUIPMENT, ELECTRICAL POWER PLANTS INCUDING UNPREDICTED CHANGES AND EMERGENCY SITUATIONS

- **Expected learning outcomes**

1.1 SURVEY, ASSESS PERFORMANCE OF ELECTRICAL POWER GENERATION AND CONSUMPTION

1.1.1 Understanding processes of power generation, distribution and consumption
1.1.2 Knowledge and understanding of electrical power quality criteria
1.1.3 Ability to define necessary monitoring parameters
1.1.4 Knowledge of electrical power plant stability and its critical characteristics
1.1.5 Understanding of mechanical and electrical energy conversion processes
1.1.6 Ability to define necessity of measures and adjustments for enhancing power efficiency and quality

1.2 SURVEY, ASSESS PERFORMANCE, PREDICT CONDITION AND ADJUST ALL ELECTRICAL, ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS

1.2.1 Understanding of electro-technical processes of complex electrical equipment
1.2.2 Knowledge of basics of reliability theory and prediction methods and ability to apply it for performance assessment, condition prediction and providing correct operation of equipment and systems
1.2.3 Knowledge of the development trends of electronics and power electronics
1.2.4 Knowledge of the development trends of computing and info-communication technology
1.2.5 Ability to adjust electrical, electronic equipment, control and communication systems in accordance with it optimal characteristic
1.2.6 Understanding of control parameters influence on equipment condition

1.3 PLAN AND MANAGE COMPLEX ACTIVITIES TO PROVIDE CORRECT OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS

1.3.1 Ability to analyse structure and performance specification of electrical and electronic equipment, control and communication systems
1.3.2 Ability to define parameters to check and maintenance periods according general recommendations, equipment makers manuals and good working practice
1.3.3 Knowledge and ability to use Vessel Management Software
1.3.4 Knowledge of marine electrical engineering practice
1.3.5 Knowledge of methods and devices providing electromagnetic compatibility of electrical and electronic equipment

1.4 MANAGE SAFE OPERATION OF POWER SYSTEMS IN EXCESS OF 1,000 VOLTS

1.4.1 Knowledge of design features of power systems in excess of 1,000 Volts
1.4.2 Knowledge of design features and configuration of operational control equipment for electrical motors and other high-voltage installations
1.4.3 Knowledge of functional, operational and safety requirements for marine high-voltage systems
1.4.4 Ability to define remedial actions necessary during faults in a high-voltage system
1.4.5 Ability to assign qualified personnel to carry out maintenance and repair of various types of high-voltage equipment

1.5 OPERATE ALL KINDS OF ELECTRICAL AND ELECTRONIC EQUIPMENT, ELECTRICAL POWER PLANTS INCUDING UNPREDICTED CHANGES AND EMERGENCY SITUATIONS

1.5.1 Knowledge of design features and system configurations of integrated control systems
1.5.2 Knowledge of design features of electrical and electronic equipment, control and monitoring systems of special purpose ships
1.5.3 Ability to learn autonomously operation principles and construction of new equipment and systems
1.5.4 Ability to gather and interpret relevant data for appreciation of equipment condition and operate it with incomplete or limited information
1.5.5 Knowledge of basics of decision making technics with regard to unpredicted changes and emergency situations in electrical and electronic equipment and electrical power plants

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

1.1 SURVEY, ASSESS PERFORMANCE OF ELECTRICAL POWER GENERATION AND CONSUMPTION

1.1.1 Explains processes of power generation, distribution and consumption
1.1.2 Explains electrical power quality criteria
1.1.3 Lists important parameters to define power efficiency and quality
1.1.4 Calculates and assess electrical power plant stability based on its parameters
1.1.5 States and explains laws and terms of energy conversion
1.1.6 Assess power efficiency in accordance with given parameters

1.2 SURVEY, ASSESS PERFORMANCE, PREDICT CONDITION AND ADJUST ALL ELECTRICAL, ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS

1.2.1 Explains electro-technical processes of complex electrical equipment based on electro-technology, electrical machines and drives theory and automation theory

1.2.2 States the basic laws and terms of reliability theory and prediction methods and explains its application in performance assessment, prediction of condition and providing correct operation of equipment and systems. Describes direct and indirect methods of parameters measuring and use this data for evaluating and predicting condition of electrical, electronic equipment, control and communication systems. Demonstrates ability to adjust and tune different electrical and electronic equipment to bring its characteristics to nominal. Assess equipment condition based on measured data

1.2.3 Explains the operation principles and performance of advanced electronic and power electronic equipment

1.2.4 Describes structure, operation principles and parameters of modern computer and info-communication systems. Demonstrates ability to use modern hardware and software associated with ship's computer and info-communication systems

1.2.5 Demonstrates ability to bring electrical, electronic equipment, control and communication systems to nominal operation by adjusting its parameters

1.2.6 Explains interrelation between electrical and electronic equipment condition and its control parameters

1.3 PLAN AND MANAGE COMPLEX ACTIVITIES TO PROVIDE CORRECT OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT, CONTROL AND COMMUNICATION SYSTEMS

1.3.1 Describes structure and performance specification of electrical and electronic equipment, control and communication systems using technical documentation

1.3.2 Demonstrates ability to define important parameters to check and explains equipment maintenance periods using manuals and general recommendations

1.3.3 Describes content and demonstrates ability to use of Vessel Management Software Solutions

1.3.4 Describes new methods and approaches to provide correct operation of electrical and electronic equipment, control and communication systems

1.3.5 States and explains basic methods for providing electromagnetic compatibility. Define harmonic components in voltage and current, equipment and control parameters for providing electromagnetic compatibility in accordance with training and/or practical tasks

1.4 MANAGE SAFE OPERATION OF POWER SYSTEMS IN EXCESS OF 1,000 VOLTS

1.4.1 Describes design features and specific processes of power systems in excess of 1,000 Volts

1.4.2 Describes design features and system configuration of operational control equipment for electrical motors and other high-voltage installations

1.4.3 Explains functional, operational and safety requirements for a marine high voltage systems. Demonstrates ability to apply such requirements when operating and maintaining high voltage systems

1.4.4 Defines remedial action procedures necessary during faults in a high-voltage system in accordance with training and/or practical tasks

1.4.5 Explains maintenance and repair procedures of various types of high-voltage equipment. Assigns qualified personnel for maintenance and repair of high-voltage equipment in accordance with training and/or practical tasks

1.5 OPERATE ALL KINDS OF ELECTRICAL AND ELECTRONIC EQUIPMENT, ELECTRICAL POWER PLANTS INCUDING UNPREDICTED CHANGES AND EMERGENCY SITUATIONS

1.5.1 Describes whole structure and each unit function of integrated control systems. Understands system configuration depending on type of the associated equipment.
1.5.2 Describes construction and explains operation principles of electrical and electronic equipment, control and monitoring systems of special purpose ships
1.5.3 Demonstrates ability to find information and understands operation principles and construction of new equipment and systems
1.5.4 Demonstrates ability to gather all essential information about equipment using advanced methods. Makes optimal decisions in situations with incomplete or limited information
1.5.5 Makes grounded decisions in emergency situations in accordance with training and/or practical tasks

2.2.2 Function: Maintenance and Repair

- **Specification of competences**

2.1 MANAGE SAFE AND EFFECTIVE MAINTENANCE AND REPAIR PROCEDURES
2.2 TESTING INTEGRATED CONTROL AND MONITORING SYSTEMS
2.3 MANAGE TROUBLESHOOTING AND RESTORATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT AND CONTROL SYSTEMS TO OPERATING CONDITION
2.4 IDENTIFY CAUSES OF MALFUNCTIONS AND CORRECT FAULTS IN ELECTRICAL AND ELECTRONIC EQUIPMENT
2.5 MANAGE RECOVERY OF ELECTRICAL POWER PLANTS AND INTEGRATED CONTROL SYSTEMS AFTER ACCIDENTS
2.6 DEFINE NECESSARY SPARE PARTS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT
2.7 ENSURE SAFE WORKING PRACTICES

- **Expected learning outcomes**

2.1 MANAGE SAFE AND EFFECTIVE MAINTENANCE AND REPAIR PROCEDURES

2.1.1 Knowledge of classification societies requirements related to the ships electrical, electronic and control systems
2.1.2 Ability to plan and schedule maintenance and repair procedures
2.1.3 Ability to use Vessel Management Software in maintenance and repair

2.2 TESTING INTEGRATED CONTROL AND MONITORING SYSTEMS

2.2.1 Knowledge and ability to use typical hardware and software for testing control systems and monitoring systems
2.2.2 Knowledge of typical structures of integrated control and monitoring systems
2.2.3 Ability to learn autonomously design features of testing hardware and software using makers' manuals

2.3 MANAGE TROUBLESHOOTING AND RESTORATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT AND CONTROL SYSTEMS TO OPERATING CONDITION

2.3.1 Knowledge of troubleshooting methods and practice
2.3.2 Ability to develop troubleshooting algorithms of electrical and electronic equipment, control and monitoring systems
2.3.3 Ability to define and provide actions necessary to restore equipment to operating condition

2.4 IDENTIFY CAUSES OF MALFUNCTIONS AND CORRECT FAULTS IN ELECTRICAL AND ELECTRONIC EQUIPMENT

2.4.1 Knowledge and understanding of interrelations of malfunctions in electrical and electronic equipment and systems and regularities of malfunctions
2.4.2 Knowledge of malfunction statistics
2.4.3 Ability to identify malfunction causes based on malfunction statistics and measurements

2.5 MANAGE RECOVERY OF ELECTRICAL POWER PLANTS AND INTEGRATED CONTROL SYSTEMS AFTER ACCIDENTS

2.5.1 Knowledge and understanding of typical accidents and its causes
2.5.2 Ability to develop recovery action plan
2.5.3 Ability to develop working algorithms for recovery of power plants and integrated control systems after accidents
2.5.4 Ability to assign personnel and allocate resources

2.6 DEFINE NECESSARY SPARE PARTS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT

2.6.1 Knowledge of malfunction specifics for different types of equipment
2.6.2 Knowledge of spare parts quantity defining methods
2.6.3 Ability to define necessary spare parts for different types of equipment

2.7 ENSURE SAFE WORKING PRACTICES

2.7.1 Knowledge of safe working practices
2.7.2 Ability to develop safety rules and instructions

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

2.1 MANAGE SAFE AND EFFECTIVE MAINTENANCE AND REPAIR PROCEDURES

2.1.1 Explains classification societies requirements related to the ships electrical, electronic and control systems. Demonstrates ability to adjust equipment for satisfying classification society's requirements
2.1.2 Demonstrates knowledge and skills in planning and scheduling of maintenance and repair procedures. Plans and schedules maintenance or repair procedures for training/practical tasks
2.1.3 Demonstrates correct practical application of Vessel Management Software in maintenance and repair

2.2 TESTING INTEGRATED CONTROL AND MONITORING SYSTEMS

2.2.1 Explains application specifics of typical testing equipment hardware and software. Demonstrates correct performance of testing procedures
2.2.2 Explains typical structures of integrated control and monitoring systems
2.2.3 Describes and explains design features of testing hardware and software based on technical documentation and maker's manuals

2.3 MANAGE TROUBLESHOOTING AND RESTORATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT AND CONTROL SYSTEMS TO OPERATING CONDITION

2.3.1 Lists and explains the most known troubleshooting methods using practical experience

2.3.2 Demonstrates ability to develop troubleshooting algorithms of electrical and electronic equipment, control and monitoring systems. Elaborates and explains troubleshooting algorithms for training and/or practical tasks

2.3.3 Defines and explains actions necessary to restore equipment to operating condition for educational and/or practical tasks. Plans and schedules restoration procedures for training and/or practical tasks

2.4 IDENTIFY CAUSES OF MALFUNCTIONS AND CORRECT FAULTS IN ELECTRICAL AND ELECTRONIC EQUIPMENT

2.4.1 Describes the most known malfunctions and the most probable causes of typical malfunctions. Explains interrelation of malfunction regularities and causes

2.4.2 Demonstrates knowledge of malfunction statistics

2.4.3 Identifies malfunction causes for training and/or practical tasks based on given information and parameters

2.5 MANAGE RECOVERY OF ELECTRICAL POWER PLANTS AND INTEGRATED CONTROL SYSTEMS AFTER ACCIDENTS

2.5.1 Describes the most known accidents in electrical power plant and integrated control systems and gives explanations of its causes

2.5.2 Defines and explains action plan for recovery electrical power plants and integrated control systems after accidents for training and/or practical tasks

2.5.3 Elaborates and explains working algorithms for recovery of power plants and integrated control systems after accidents in accordance with training and/or practical tasks

2.5.4 Describes basic principles of personnel assigning and resource allocating. Assigns personnel and allocate resources effectively for training and/or practical tasks

2.6 DEFINE NECESSARY SPARE PARTS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT

2.6.1 Describes typical malfunctions, its causes and consequences for different types of electrical and electronic equipment

2.6.2 Explains basic methods for spare parts quantity defining

2.6.3 Defines necessary spare parts for different types of electrical and electronic equipment in accordance with training and/or practical tasks

2.7 ENSURE SAFE WORKING PRACTICES

2.7.1 Describes the most known safe working practices. Describes the most known accidents connected with violations of safety

2.7.2 Develops safety rules and/or instructions in accordance with training and/or practical tasks

2.2.3 Function: Controlling the Operation of the Ship and Care for Persons on Board

- **Specification of competences**

3.1 MANAGE AND SUPERVISE COMPLEX ACTIVITIES OF ELECTRO-TECHNICAL PERSONNEL
3.2 MONITOR AND CONTROL COMPLIANCE WITH LEGISLATIVE REQUIREMENTS AND MEASURES RELATED TO ELECTRICAL AND ELECTRONIC EQUIPMENT AND SYSTEMS TO ENSURE SAFETY OF LIFE AT SEA AND PROTECTION OF THE MARITIME ENVIRONMENT
3.3 MANAGE DEVELOPMENT OF PROFESSIONAL KNOWLEDGE AND SKILLS OF ELECTRO-TECHNICAL PERSONNEL
3.4 ORGANIZE SHIPBOARD PERSONNEL TRAINING RELATED TO OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT INCLUDING EMERGENCY SITUATIONS
3.5 DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS RELATED TO ELECTRICAL EQUIPMENT
3.6 MAINTAIN SAFETY AND SECURITY OF THE VESSEL, CREW AND PASSENGERS AND THE OPERATIONAL CONDITON OF THE LIFE SAVING, FIRE FIGHTING AND OTHER SAFETY SYSTEMS

- **Expected learning outcomes**

3.1 MANAGE AND SUPERVISE COMPLEX ACTIVITIES OF ELECTRO-TECHNICAL PERSONNEL

3.1.1 Knowledge and understanding of basic personnel management principles
3.1.2 Ability to apply task and workload management
3.1.3 Knowledge of shipboard resource management

3.2 MONITOR AND CONTROL COMPLIANCE WITH LEGISLATIVE REQUIREMENTS AND MEASURES RELATED TO ELECTRICAL AND ELECTRONIC EQUIPMENT AND SYSTEMS TO ENSURE SAFETY OF LIFE AT SEA AND PROTECTION OF THE MARITIME ENVIRONMENT

3.2.1 Knowledge of international maritime conventions and recommendations and national legislative requirements related to ensure safety of life at sea and protection of the maritime environment
3.2.2 Ability to plan and manage activities to provide working condition of electrical and electronic equipment and systems to ensure safety of life at sea and protection of the maritime environment

3.3 MANAGE DEVELOPMENT OF PROFESSIONAL KNOWLEDGE AND SKILLS OF ELECTRO-TECHNICAL PERSONNEL

3.3.1 Ability to communicate effectively onboard and ashore
3.3.2 Ability to find necessary information sources and deliver it to electro-technical personnel
3.3.3 Ability to assess, review and develop performance of individuals and groups

3.4 ORGANIZE SHIPBOARD PERSONNEL TRAINING RELATED TO OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT INCLUDING EMERGENCY SITUATIONS

3.4.1 Ability to explain the operation principle and hazards of electrical and electronic equipment to nonelectrotechnical shipboard personnel
3.4.2 Ability to explain actions to be taken in emergency situations related to electrical and electronic equipment
3.4.3 Ability to define methods of demonstration and assess performance

3.5 DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS RELATED TO ELECTRICAL EQUIPMENT

3.5.1 Knowledge and ability to apply decision-making techniques to solve complex and unpredictable problems related to electrical and electronic equipment and systems
3.5.2 Ability to develop clear safety procedures in emergency situations related to electrical equipment
3.5.3 Ability to handle emergency situations related to electrical equipment

3.6 MAINTAIN SAFETY AND SECURITY OF THE VESSEL, CREW AND PASSENGERS AND THE OPERATIONAL CONDITON OF THE LIFE SAVING, FIRE FIGHTING AND OTHER SAFETY SYSTEMS

3.6.1 Knowledge of life-saving appliances regulations
3.6.2 Ability to organize fire and abandon ship drills
3.6.3 Knowledge of maintenance and testing procedures of life-saving, fire-fighting and other safety systems
3.6.4 Knowledge of actions to be taken to protect and safeguard all persons on board in emergencies

- **Demonstration of learning outcomes**

This topic provides list of knowledge and activities that student must show to cover each learning outcome

3.1 MANAGE AND SUPERVISE COMPLEX ACTIVITIES OF ELECTRO-TECHNICAL PERSONNEL

3.1.1 Demonstrates ability to manage personnel in complex activities using good psychological approach
3.1.2 Applies tasks and allocates workload in accordance with training and/or practical tasks taking into account qualification and personal qualities of subordinates
3.1.3 Explains shipboard resource management and apply it when managing and supervising duties of electro-technical personnel

3.2 MONITOR AND CONTROL COMPLIANCE WITH LEGISLATIVE REQUIREMENTS AND MEASURES RELATED TO ELECTRICAL AND ELECTRONIC EQUIPMENT AND SYSTEMS TO ENSURE SAFETY OF LIFE AT SEA AND PROTECTION OF THE MARITIME ENVIRONMENT

3.2.1 Applies knowledge of international maritime conventions, recommendations and national legislative requirements in emergency situations and daily routine

3.2.2 Develops action plan to provide working condition of electrical and electronic equipment and systems to ensure safety of life at sea and protection of the maritime environment according to training or practical task

3.3 MANAGE DEVELOPMENT OF PROFESSIONAL KNOWLEDGE AND SKILLS OF ELECTRO-TECHNICAL PERSONNEL

3.3.1 Demonstrates skills in communication with electro-technical personnel regarding to development their professional knowledge and skills
3.3.2 Demonstrates skills in defining and searching information needed for development of electro-technical personnel professional knowledge
3.3.3 Assesses, reviews and develops performance of individuals and groups in accordance with training and/or practical tasks

3.4 ORGANIZE SHIPBOARD PERSONNEL TRAINING RELATED TO OPERATION OF ELECTRICAL AND ELECTRONIC EQUIPMENT INCLUDING EMERGENCY SITUATIONS

3.4.1 Explains the operation principle and hazards of electrical and electronic equipment to nonelectrotechnical crew members in understandable form. Assesses understanding of given information
3.4.2 Explains to crew members the actions to be taken in emergency situations related to electrical and electronic equipment. Assesses understanding of given information
3.4.3 Defines methods of demonstration and assesses performance in accordance with training and/or practical tasks

3.5 DEVELOP EMERGENCY AND DAMAGE CONTROL PLANS AND HANDLE EMERGENCY SITUATIONS RELATED TO ELECTRICAL EQUIPMENT

3.5.1 Demonstrates skills in decision-making technics to solve complex and unpredictable problems relating to electrical and electronic equipment and systems. Makes correct decisions in accordance with training and/or practical tasks
3.5.2 Understands action sequences in emergency situations related to electrical and electronic equipment. Develops emergency and damage control plans related to electrical and electronic equipment
3.5.3 Understands crowd management. Develops emergency control plan in accordance with training and/or practical task

3.6 MAINTAIN SAFETY AND SECURITY OF THE VESSEL, CREW AND PASSENGERS AND THE OPERATIONAL CONDITON OF THE LIFE SAVING, FIRE FIGHTING AND OTHER SAFETY SYSTEMS

3.6.1 Explains life-saving appliances regulations
3.6.2 Demonstrates ability to organize fire and abandon ship drill
3.6.3 Explains procedures and periods of maintenance of life-saving, fire-fighting and other safety systems
3.6.4 Demonstrates skills in protection and safeguarding of all persons on board in emergencies

2.3 Teaching syllabus

2.3.1 List of subjects and students'/trainees' workload

№	Subject	References to expected learning outcomes	Workload hours
S.2.1	Energy efficiency and quality	1.1.1-1.1.3, 1.1.5, 1.1.6, 1.2.1	60
S.2.2	Dynamic processes in ship electrical power plants	1.1.4, 1.2.1	60
S.2.3	High voltage power systems	1.2.1, 1.3.5, 1.4.1-1.4.4	60
S.2.4	Info-communication technology	1.2.4, 1.2.5, 2.2.3	90
S.2.5	Advanced electrical drives and power electronics	1.2.1, 1.2.3, 1.2.5, 1.2.6, 1.3.5, 2.2.3	60
S.2.6	Special purpose ships electrical and electronic equipment	1.2.1, 1.2.6, 1.5.2, 1.5.3, 2.2.3	90
S.2.7	Integrated control systems	1.2.6, 1.5.1, 2.2.1- 2.2.3	60
S.2.8	Electrical installation in hazardous area	1.2.1, 1.2.2, 1.2.5, 1.3.1, 1.3.3, 1.5.2, 1.5.4, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.3.3, 2.4.1, 2.5.1, 2.6.1, 2.7.1, 2.7.2, 3.2.1, 3.4.1	60
S.2.9	Management of maintenance and repair of electrical and electronic equipment	1.2.2, 1.3.1, 1.3.2, 2.1.1, 2.3.1-2.3.3, 2.4.2, 2.4.3, 2.5.3, 2.6.2, 2.6.3, 3.2.2	60
S.2.10	Decision making techniques	1.5.4, 1.5.5, 2.3.3, 3.5.1	30
S.2.11	Marine electrical engineering practice	1.3.4, 2.4.1, 2.4.2, 2.5.1, 2.6.1, 2.7.1	30
S.2.12	Vessel management software	1.3.3, 2.1.2	30
S.2.13	Onboard safety and security ensuring	3.2.1, 3.2.2, 3.4.1, 3.5.2, 3.5.3, 3.6.1-3.6.4	30
S.2.14	Interpersonal communication	3.3.1, 3.3.2, 3.4.1, 3.4.2	30
S.2.15	Personnel and resource management	1.4.5, 2.3.3, 2.5.2, 2.5.4, 2.7.2, 3.1.1-3.1.3, 3.3.2, 3.3.3, 3.4.3, 3.5.3	60
Total hours			810

Workload indicates the time that student (trainee) typically need to complete all learning activities required to achieve the expected learning outcomes. Workload embraces the time spent on independent work, compulsory work placements, preparation for assessment and the time necessary for the assessment. It includes hours for lectures, laboratory and practical works, workshops, seminars, individual tasks and projects, self-study and examinations.

The proposed course timetable is based on modular principle with standardized size of all course components. Each subject (module) has the same value (30 hours) or multiples of it (e.g. 60, 90, …). Presented number of hours is approximate and can be corrected depending on accepted teaching methodology, available teaching facilities and equipment and level of students' (trainees') readiness.
Educational (training) institution should define workloads for different types of learning activities. It is important to take into account need of the students (trainees) independent work as for performance of individual tasks, self-study, and preparation for examinations and for preparation for contact hours. It has to be taken into account that different types of learning activities can require different volume of independent work. So, laboratory work and lecture may require the same number of contact hours, but one may require significantly greater workload than the other because of differing amounts of independent preparation by students (trainees).
The estimation of workload should be periodically refined through monitoring and students (trainees) feedback.

2.3.2 Description of subjects

S.2.1 Energy efficiency and quality

The study in this subject provides the knowledge of:

- processes and efficiency indices of energy conversion:
  - mechanical-to-electrical
  - electrical-to-mechanical
- power generation and consumption in complex electrical power systems
- architecture and design of Integrated Electric Power System
  - power generation modules, power distribution modules, power conversion modules, energy storage modules, propulsion motor modules, power management system modules
- influence of power system configuration on energy efficiency
- influence of electrical load on prime mover condition
- energy efficiency enhancement methods
- energy efficiency enhancement equipment
- optimization and energy utilization
- active and reactive power control, reactive power compensation
- asymmetric load sharing, power factor compensation
- disturbances in ship electric power systems
- measurement instrumentation of ship electric power plant
- power quality monitoring systems
- quality of power and its determinants
- power quality and operation of ship technical systems
- indices of power quality
- methods of determination of selected indices of power quality
- improvement of power quality in ship electric power systems

S.2.2 Dynamic processes in ship electrical power plants

The study in this subject provides the knowledge of:

- electrotechnical processes based on laws of: electro-technology; electrical machines and drives theory; automation theory
- maximum and limited loads
- transient process quality
- static, dynamic and resultant stability of electrical power plant
- evaluation of electrical power plant stability based on its parameters
- static stability criterions
- evaluation of electrical power plant dynamic stability
- dynamic and resultant stability criterions
- transient and subtransient internal voltage
- inductive parameters of synchronous machine
- synchronous machine electromagnetic transient process equation
- transient processes specifics with low and high disturbances
- short circuit; general features and types of short circuits
- short circuit current calculation methods
- transient processes of synchronizing and parallel operation of generators
- asynchronous mode of synchronous generators operation; resynchronizing
- traction mode of generators

- generators transient processes at active and reactive load connecting and disconnecting
- frequency, voltage and load changing in electrical power plants
- transient processes at induction motor automatic reconnection
- stability and transient processes quality enhancement measures
- frequency, voltage and power limiters

S.2.3 High voltage power systems

The study in this subject provides the knowledge of:

- principles of high voltage distribution
- operational and safety requirements for marine high-voltage systems
- review of high voltage safety rules and procedures
- issue and control of safety documentation
- configuration and design features of high voltage power systems
- high voltage AC and DC power generation
- typical marine high voltage system voltages, typical high voltage generating sets
- typical high voltage distribution installations
- configuration and design features of operational control equipment for electrical motors and other high-voltage installations
- maintenance of circuit breakers: oil / gas / air / vacuum
- nature and forming of electric stresses, electric stresses in laminar structures, surface discharges
- break-down strength of solid dielectrics, discharge mechanism in solids
- ageing of electrical insulation
- testing of electrical insulation strength
- overvoltage and surge protection methods and devices
- appreciation of fault levels
- fault calculations
- operation of power systems during planned and fault shutdowns
- fault remedial procedures in a high-voltage systems
- actions to be taken during loss of high voltage control facilities
- simulated and practical exercises

S.2.4 Info-communication technology

The study in this subject provides the knowledge of:

- analog and digital transmission
- systems of data transmission and message passing
- transmission speed; data rate
- messages and transmission channels
- closed and open medium of transmission (wire, cable and wireless transmission)
- asynchronous methods of transmission and modems; interfaces
- synchronous-digital modems
- multiplexing technologies
- protocols and errors check (half duplex and duplex protocols)
- info-communication technology software; communication programs
- remote access services
- Global networks architecture (GMDSS, INMARSAT, LRIT, AIS)
- packets networks

- local area networks; Ethernet; work exchange devices (gateways, bridges and routers)
- Internet (structure, protocols, services)
- Integrated Services Digital Network (ISDN)
- wireless networks
- basics of information security

S.2.5 Advanced electrical drives and power electronics

The study in this subject provides the knowledge of:

- principles of electromagnetic energy conversion, single and doubly excited system, calculation of air gap flux and magnetic motive force (MMF)
- basic structure and modeling of AC electric machines and power electronic converters
- reference frame theory of AC machine
- dynamic characteristics of permanent magnet and shunt DC motors
- modeling of an induction machine based on complex space vector, torque of induction machine
- modeling of a synchronous machines based on complex space vector, torque of synchronous machine
- equivalent circuit and torque of a permanent magnet synchronous machine
- torque speed characteristics of ships typical mechanical loads
- design of controllers for electric machines and power electronic converters
- direct and indirect vector control of induction motor
- rotor flux linkage estimator, flux weakening control, flux controller of induction machine
- direct torque control principle, stator flux and torque calculations
- AC drives sensorless vector and direct torque control, control of the slip-ring induction machine
- vector and direct torque control of synchronous drives, vector control of permanent-magnet synchronous machines
- power electronic converters: configurations; switching devices; phase-shifting transformers
- ship high power AC and DC drives
- electromagnetic compatibility (EMC): standards; harmonics generated by power electronic converters and their reducing in the main supply system; power factor and harmonic distortion; acceptable distortion level
- voltages and current on the AC motors side of pulse-width modulation (PWM) inverters; selection of adequate switching frequency; compliance with EMC standards
- efficiency evaluation of converter fed AC and DC electric drives

S.2.6 Special purpose ships electrical and electronic equipment

The study in this subject provides familiarization with operating principle and general specification of special-purpose equipment of following ships' types:

- oil tankers
- gas tankers
- chemical tankers
- roll-on roll-off ships
- drilling ships and platforms
- harbor, seagoing and anchor handling tugboats
- cable layers
- pipe layers

- research vessels
- supply vessels
- survey vessels
- icebreakers
- dredgers
- crane vessels
- well stimulation vessels
- semi-submersible heavy transport vessels
- diving support vessels
- fire fighting vessels
- floating production storage and offloading units

It is recommended to learn special-purpose equipment of other ships' types on choice of educational (training) institution

S.2.7 Integrated control systems

The study in this subject provides the knowledge of:

- main objective of integrated control
- integrated control systems configuration of different ships' types
- classification societies requirements to integrated control systems
- distinguishing automation marks
- design features of integrated monitoring systems
- design features of integrated control systems
- integrated control system hierarchy
- algorithms developing principles for different hierarchy levels of integrated control system
- design features of centralized control systems
- design features of distributed control systems
- integrated control system hardware
- integrated control system software
- operator stations
- process stations
- integrated control system equipment parameters
- integrated control system condition assessment
- role of operators in integrated control system
- human-machine interface
- ergonomics in integrated control systems
- typical testing hardware and software of integrated control systems
- design features of systems to assist decision making
- fault-tolerant control systems
- practical exercises in integrated control systems design features analysis
- practical exercises in integrated control systems testing

S.2.8 Electrical installation in hazardous area

The study in this subject provides the knowledge of:

- properties of flammable substances:
  LEL (Low Explosive Level), UEL (Upper explosive Level), (auto)ignition temperature, flash point, MIE (Minimum Ignition Energy), MESG (Maximum Experimental Safe Gap), MIC

(Minimum Igniting Current), influence of inert gas (flammable area); for dust: minimum ignition temperature
- temperature classes of flammable gases (IEC, American approach)
- classification of explosive mixtures (IEC, American approach)
  - classification of gas explosive mixtures
  - classification of dust explosive mixtures
- classification of hazardous areas (gas, dust)
  - zones concept (IEC approach)
  - division concept (American approach)
  - classification of ship's hazardous areas according to IEC-60092-502 standard
- explosionproof types of protection of electrical equipment for gas-explosive area:
  - flameproof enclosures "d"
  - pressurized enclosures "px, py, pz"
  - powder filling "q"
  - oil immersion "o"-(limited application on ships)
  - increased safety "e"
  - intrinsic safety "ia, ib, ic, FISCO"
  - non-incendive "nA, nC, nL, nR, nP"
  - encapsulation "ma, mb, mc"
  - optical radiation "op is, op pr, op sh"
  - special "s"
- explosionproof types of protection of electrical equipment for dust-explosive area
- explosionproof types of protection of nonelectrical equipment
- cabling in hazardous areas
- intrinsic safety systems (intrinsic safety apparatus as: sensors, transducers; associated apparatus as: Zener barriers, separators or isolators; simply apparatus; cabling...)
- records all electrical equipments on board of ship (certificates)
- maintenance and inspection of electrical explosionproof equipment
  - initial inspection, periodic inspection, sample inspection
  - visual inspection, close inspection, detailed inspection
  - annual survey, intermediate survey, renewal survey
  - records of inspections
- equipment repair, overhaul and reclamation
- marking of explosionproof equipment
- Ex certificate: IECEx, ATEX and American approach
- selection of the equipment according IECEx, ATEX and American approach:
  - EPL (Equipment Protection Level)
  - Categories concept
  - American approach
  - IGC Code - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk - requirements
  - IBC Code - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk - requirements
  - MODU Code – Code for the Construction and Equipment of Mobile Offshore Drilling Units – requirements
  - explosionproof equipment on other ships than tankers
- classification societies requirements

S.2.9 Management of maintenance and repair of electrical and electronic equipment

The study in this subject provides the knowledge of:

- classification societies requirements to electrical and electronic equipment
- general procedures of maintenance and repair of ship electrical and electronic equipment
- electrical equipment maintenance plans and schedules
- electrical equipment engineering supervising
- electrical and electronic equipment repair planning and managing
- repair types of electrical and electronic equipment
- repair sheets preparation
- electrical equipment reliability factors
- failure classification and lifetime distribution of electrical equipment
- reliability calculation of simple and complex electrical systems
- equipment longevity
- performance loss and limit condition of equipment
- repairability of electrical and electronic equipment
- electrical spare parts provision
- spare parts kits and quantity defining
- electrical and electronic equipment diagnostic methods
- working capacity defining methods
- defects defining methods
- troubleshooting algorithms developing
- electrical and electronic equipment condition prediction methods
- electrical and electronic equipment malfunction statistics analysis
- system approach to electrical equipment structure, performance and condition analysis
- practical exercises on analyzing structure, performance specification and troubleshooting of electrical and electronic equipment, control and communication systems
- defining and providing actions necessary to restore electrical power plant and other equipment to operating condition after accidents
- practical tasks on developing of working algorithms for recovery of power plants and integrated control systems after accidents
- construction, operation principle and parameters of electrical and electronic equipment which is intended to provide safety of life at sea and protection of the maritime environment

S.2.10 Decision making techniques

The study in this subject provides the knowledge of:

- decision making stages
  - orientation stage, conflict stage, emergence stage, reinforcement stage
- problem analysis
  - analyze performance and deviations from performance standards
  - problem identifying and describing
  - defining causes of problem
- decision making steps
  - gathering data
  - developing alternatives
  - pros and cons of alternatives evaluation
  - making decision
  - implementation of the decision

    - monitoring and assessment of outcomes
- alternatives
    - objectives establishing and objectives classifying
    - defining objectives priorities
    - defining of restrictions
    - defining alternative actions
    - evaluation of alternative actions
    - tentative decision
- cognitive styles
    - Myers-Briggs type indicator:
    - thinking and feeling;
    - extroversion and introversion;
    - judgment and perception;
    - sensing and intuition
- optimizing vs. satisfying
    - "maximizers" (optimal decision)
    - "satisficers" ("good enough")
- making the decision
    - decision making major styles (positional, combinational)
    - defining decision making criteria
    - Descartes' method (Descartes' square)
    - decision planning
- situation and risk assessment
- defining monitoring criteria
- decision-making at uncertainty or incomplete information
- basic approaches to the uncertainty
    - deterministic (combinational style)
    - indeterministic (positional style)
- post-decision monitoring and analysis

S.2.11 Marine electrical engineering practice

The study in this subject provides update knowledge based on familiarization with:

- accidents analysis
- malfunction statistics
- malfunction specifics for different types of equipment
- new technologies
- new methods and approaches to providing energy efficiency
- new methods and approaches of maintenance and repair
- equipment upgrading experience

It is recommended to provide study in this subject based on marine engineering publications, reviews, companies' reports, modern guidance and etc. Such information sources should be regularly updated

S.2.12 Vessel management software

The study in this subject provides the knowledge of:

- shipping company technical management
- database content

- software installation and updating (practical exercises)
- program interface and functions setting
- information searching in database, work with filters and help (practical exercises)
- creating a new unit with spare parts and routine maintenance schedule in database
- graphic applications
- work orders administration
- works prioritization
- unscheduled works reports
- group works scheduling and reports
- printing a list of works in the beginning of the month
- records on maintenance
- inventory (stock) control; stock-taking
- records on stock operations
- stock demands defining
- creating and deleting items in stock
- requisitions creating
- budget keeping
- data transferring to office (practical exercise)
- import to database received information (practical exercise)

It is recommended to provide training in this subject based on typical Vessel Management Software Systems, for example - AMOS (Asset Management Operating System)

S.2.13 Onboard safety and security ensuring

The study in this subject provides the knowledge of:

- life-saving appliances and arrangements (Chapter III of SOLAS) and Life-Saving Appliance Code
- construction, installation and operation of life saving equipment
- tests, procedures and maintenance necessary to ensure correct and safe operation of life-saving and other safety equipment
- maintenance of electrical equipment of water tight doors
- construction, installation and operation of fixed firefighting installations
- construction, installation and operation of portable and semi portable fire-fighting equipment
- fire drill procedures, responsibilities of each person involved in fire drill
- abandon ship procedures, responsibilities of each person involved in abandon ship drill
- International Ship and Port Facility Security Code
- ship security plan
- shipboard personnel security responsibilities
- ship security equipment

S.2.14 Interpersonal communication

The study in this subject provides the knowledge of:

- culture as a base of effective communication
- communicative function of culture
- professional and national culture
- culture specification; identification of leading cultures in the world
- political and economic systems of the most powerful states

- morals, ethics, values
- main characteristics of communication
- verbal and nonverbal means of communication
- effective speech communication technique
- perception and understanding of the partner in communication
- psychological types of the personality; temperament
- basic psychological principles of influence on the person
- correct and incorrect funds of influence for the person
- protection against incorrect persons
- uncertainty avoidance
- preparation and carrying out business meeting
- features of communication with women and men
- criticism, types of criticism
- contradictions, manipulation in contradictions
- proofs and arguments, principles of the argument
- manner, mimicry and gestures of the speaker
- onboard communication specificity
- most famous accidents in communication sphere

S.2.15 Personnel and resource management

The study in this subject provides the knowledge of:

Management of personnel

- marine transport management specifics
- human involvement in errors
- attitudes and management skills
- role of personality in management
- authority and assertiveness
- management styles
- personnel motivation
- leadership; influence methods
- “power distance index” in management and cross-cultural leadership
- leadership in emergencies
- planning and co-ordination
- personnel assignment
- action planning in emergencies
- conflict; conflict situation management
- group as object of management
- crisis and crowd management
- training of personnel:
  - defining objectives, training outcomes, methods of demonstration and assessment criteria
  - training plan developing
  - typical assessment methods
- Maritime Labour Convention, 2006 (MLC 2006)
- principles of safe manning
- prevention of fatigue

Resource management

- situation awareness
- challenges and responses

- allocation, assignment and prioritization of resources
- time and resource constraints
- short term strategy
- workload: task analysis, delegation and rotation of tasks
- workload management in time limit condition
- state of the ship

Ship management systems

- management systems adopted on ships at present:
  - International Safety Management Code (ISM Code)
  - International Code for the Security of Ships and Port Facilities (ISPS Code)
  - International Standard ISO 9001:2008 “Quality Management Systems”
  - International Standard ISO 14001:2004 “Environmental Management Systems”
  - OHSAS 18001: 2007 “Occupational Health and Safety Management Systems”
  - International Standard ISO 31000:2009 “Risk management”
- policies and objectives of the management systems
- principles of the management systems:
  - customer focus
  - involvement of people
  - process approach
  - system approach to management
  - preventive approach
  - considering processes in terms of added value
  - continual improvement of the management system
  - improvement of process performance and effectiveness
  - factual approach to decision making
  - mutually beneficial customer-supplier relationships
- structural elements the management systems
- functional elements the management systems
- role of ship’s officers within the management system:
  - to establish and maintain the management system policy and objectives of the ship
  - to promote the management system policy and objectives throughout the ship to increase awareness, motivation and involvement
  - to ensure focus on customer requirements throughout the ship
  - to ensure that appropriate processes are implemented to enable requirements of customers and other interested parties to be fulfilled and management system objectives to be achieved
  - to ensure that an effective and efficient management system is established, implemented and maintained to achieve these management system objectives
  - to ensure the availability of necessary resources
  - to review the management system periodically
  - to decide on actions regarding:
    - the management system policy and objectives
    - determination of non-conformities, their causes and corrective and preventive action
    - improvement of the management system
  - to exercise leadership

2.3.3 Assessment

Assessment enables the assessor (tutor) to ascertain if the student (trainee) has achieved the planned learning outcomes at a given point in a course or in working towards a qualification. Learning outcomes describe outcomes which are to be achieved by the student (trainee). It is important that student's (trainee's) achievements have to be measured objectively through an evaluation which will not be influenced by the personal opinions and judgements of the examiner. Objective evaluation provides a sound base on which to make reliable judgements concerning the levels of learning outcomes achieved, thus allowing an effective evaluation to be made of the progress of students (trainees) in a Course.

It is recommended to assess achieved learning outcomes and appropriate competencies by consecutive assessment of outcomes of each subject and comprehensive assessment at the end of the course.

It is recommended to assess learning outcomes of subject (module) trough one of the following methods:

- written examination;
- oral examination;
- tests;
- solution of practical tasks (including simulator-based exercises);
- laboratory reports;
- performance at a seminars and/or practical exercises (written or oral questions);
- assignments, activities, projects, tasks and/or case studies;
- records and reports of practical training.

It is possible to use a combination of two or more stated above methods to for assessment of learning outcomes of one subject. As an example: laboratory reports or reports of practical exercises can be used for evaluation ability to execute or solve practical tasks and oral or written examination can be used for evaluation knowledge, understanding or cognitive skills.

The evaluation methods must be based on clearly defined objectives, and must truly represent what is meant to be assessed; e.g. against only the relevant criteria and the syllabus or course guide. It is important to select the assessment method most appropriate to the particular aspect of competence to be evaluated.

The assessors (tutors) need to know what they are to assess and then decide how to do this. The, what, will come from the expected learning outcomes of the subject / course they are delivering.

Assessment method or combination of assessment methods should be defined depending of method (methods) of demonstration of learning outcomes as recommended in sections «Demonstration of learning outcomes» in paragraphs 2.2.1; 2.2.2; 2.2.3 of this Course. In this regard the following methods are recommended for evaluation different kinds of Demonstrations of learning outcomes:

- states, explanations, demonstration of knowledge and so on can be assessed by both of performance at a practical exercises and seminars or oral examination or test;
- demonstration of cognitive skills should be assessed by written examination;
- demonstration of practical, manual skills and practical-oriented abilities can be assessed trough laboratory reports or practical exercises in classrooms or on simulators.

Assessment should also be reliable. Different groups of students (trainees) may have the same subject at different times. If other assessors are also assessing the same subject / course, there is need to ensure all are making the same decisions. To be reliable an evaluation procedure should produce reasonably consistent results, no matter which set of papers or version of the test is used.

For this level of qualification it is important to use appropriate methods to assess the abilities related to the management competencies. Development and implementation into study (training) process corresponding training and/or practical tasks or projects are recommended for this purpose.

For objectivity it is recommended to use more written examinations than oral. Examinations shouldn't be very long - no more than 2 - 3 hours.
It is recommended at examinations to avoid questions that require learning by rote only. The questions shall cover following aspects as minimum: knowledge; understanding; application of knowledge and understanding to solution of practical tasks.
Taking into account that different national educational and training systems have developed different approaches to grading which are deeply rooted in their pedagogical and cultural traditions, educational (training) institutions are recommended to keep track of their grading practice and culture, which is a good practice in many institutions.
However it is important that criteria of the successful Course / Course component completion have to be based on expected learning outcomes as mandatory requirements

Annex A Training Record Book

1 Guidance

1.1 Introduction

Combined workshop skills training and approved seagoing service of the future Electro-Technical Officers should be done according to the requirements of the Regulation III/6 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 2010 (STCW 1978/10).

1.2 Personal details

In this section student (trainee) must enter all necessary personal and educational/training institution details and paste the photo for identification.

1.3 Workshop training

Subsection Workshop training summary includes list of workshops, duration of each workshop training, name and signature of authorized person who approve workshop practice based on workshop training officer assessment.
Subsection Task description and performance includes name of Company/Institution, Workshop/Department and information of tasks carried out. Workshop training officer must evaluate performance of tasks completing and sign.

1.4 Onboard training

This section includes subsections which indicate onboard training completion progress and inspection by company training officers, masters and chief engineers and onboard training officers.
The company training officer should be responsible for:

- overall administration of the programme of training;
- monitoring the progress of the prospective officer throughout; and
- issuing guidance as required and ensuring that all concerned with the training programme play their parts.

The master's responsibilities should be to:

- provide the link between the shipboard training officer and the company training officer ashore;
- fulfil the role of continuity if the shipboard training officer is relieved during the voyage; and
- ensure that all concerned are effectively carrying out the onboard training programme.

The shipboard training officer should be responsible for:

- organizing the programme of practical training at sea;
- ensuring, in a supervisory capacity, that the training record book is properly maintained and that all other requirements are fulfilled; and
- making sure, so far as is practicable, that the time the trainee spends on board is as useful as possible in terms of training and experience, and is consistent with the objectives of the training programme, the progress of training and the operational constraints of the ship.

The trainee responsibilities should be to:

- follow diligently the programme of training as laid down;
- make the most of the opportunities presented, be they in or outside working hours; and
- keep the training record book up to date and ensure that it is available at all times for scrutiny.

Seagoing service summary subsection includes two tables which indicate training sea service. First table must be signed and stamped by company responsible person. Second table must be signed and stamped by Master.
Seagoing service testimonials subsection includes ship, trainee personal data and table with trainee personal characteristics. Personal characteristics and possible recommendations for promotion must be evaluated by Chief engineer and signed by both of them Chief engineer and Master.
Inspection by company training officer subsection includes approval of each training period. Company training officer must confirm and give general assessment of onboard training program completion based of Chief engineer and onboard training officer remarks.
Inspection by Chief engineer subsection indicates each ship Chief engineer approval. Chief engineer must confirm onboard training program completion, based on onboard training officer records, shipboard and safety familiarization, ship's particulars, training tasks performance
Review by onboard training officer subsection indicates comments, name and signature of onboard training person designated by Company or Master. Onboard training officer comments must represent trainee knowledge, understanding, professional competence, performance of duty assignments and general assessment of training program completion.

1.5 Specimen signatures of officers and other experienced staff authorised to sign off tasks, records and reports

This section includes personal details and specimens of initials and signatures of all officers and other personnel, who are authorised to sign off tasks. This can help to identify each person signed on tasks completion.

1.6 Shipboard and safety familiarization

This section includes list of safety familiarisation tasks which must be completed in the beginning of each sea going practice. Task completion must be signed by officers depending on which responsibility this task corresponds.

1.7 Ships' particulars

This section includes detailed information of ship, facilities and equipment, found by student (trainee) in ships' manuals and/or other documents. On completion it must be inspected and signed by onboard training officer.

1.8 Training tasks performance

This section includes list of training tasks which correspond to all functions and competences presented in Part 1 of this MODEL COURSE.
It may be not possible for the student (trainee) to complete some tasks listed in this section due to the type of joined ship. In this case, an appropriate information should be written at the task which was not completed.
It is not necessary to complete all tasks on one ship. It can be done on different ships.
Student (trainee) should complete the tasks in such a manner, that the onboard training officer is absolutely sure of satisfactory performance of student's (trainee's) competence.
In some cases trainee can be obliged to fulfil the tasks more than once. The decision to repeat the task should be made by onboard training officer.
When the student (trainee) completes the task, onboard training officer or other authorized officer confirms it with their signature in the appropriate space of a given task.

2 Personal details

Photo

Full name	
Home Address	
Date of Birth	
Number of the Seaman's Seagoing Service Record Book	
Tel:	Mobile:
E-mail:	

Educational/Training Institutions

Name:		
Faculty/Department:		
Address:		
E-mail:	Tel:	
Study/Training period	From:	To:
Name:		
Faculty/Department:		
Address:		
E-mail:	Tel:	
Study/Training period	From:	To:

3 Workshop training

3.1 Workshop training summary

№	Company/Institution	Training period		Responsible person (name and position)	Signature and stamp
		From	To		

3.2 Tasks description and performance

Company/Institution_____
Workshop/Department_____
Tasks description_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

General assessment_____(excellent, good, satisfactory, not satisfactory)

Training officer_____
(Name, position)

Signature_____

Company/Institution_____
Workshop/Department_____
Tasks description_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

General assessment_____(excellent, good, satisfactory, not satisfactory)

Training officer_____
(Name, position)

Signature_____

Company/Institution_____
Workshop/Department_____
Tasks description_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

General assessment_____(excellent, good, satisfactory, not satisfactory)

Training officer_____
(Name, position)

Signature_____

4 Onboard training

4.1 Seagoing service summary

Company confirmation

№	Company	Ship name	Training period		Company responsible person (name and position)	Signature and stamp
			From	To		

Seagoing service details

№	Ship name	IMO №	Propulsion power, kW	Position	Training period		Master (name and signature)	Ships' stamp
					From	To		

4.2 Seagoing service testimonials

Name of ship: m/v …… IMO Number ……..…..… Ship type ……..

Full name of candidate ……..... Date of birth …….. Position……

Seaman's Seagoing Service Record Book No ……On board from …… to …..…..

Total sea service M……D.....

Characteristics	Excellent	Very good	Good	Satisfactory	Unfit
Professional competence and knowledge					
Attitude and conduct					
Intelligence and sobriety					
Performance of duty assignments					
Cooperation with crew and officers					
Cleanliness and personal appearance					

Recommended for promotion: □ Yes, □ No.

If yes, to what position? ……...

If no, explain and indicate what could lead to progress?……..
……
……

Remarks:……
……
……
……

…….. …… ……
Date Chief Engineer Master

Name of ship: m/v …… IMO Number ……..…..… Ship type ……..

Full name of candidate ……..... Date of birth …….. Position……

Seaman's Seagoing Service Record Book No ……On board from …… to …..…..

Total sea service M……D.....

Characteristics	Excellent	Very good	Good	Satisfactory	Unfit
Professional competence and knowledge					
Attitude and conduct					
Intelligence and sobriety					
Performance of duty assignments					
Cooperation with crew and officers					
Cleanliness and personal appearance					

Recommended for promotion: □ Yes, □ No.

If yes, to what position? ……...

If no, explain and indicate what could lead to progress?……..
……
……

Remarks:.……
……
……
……

…….. …… ……
Date Chief Engineer Master

Name of ship: m/v …… IMO Number ……..…..… Ship type ……..

Full name of candidate ……..... Date of birth …….. Position……

Seaman's Seagoing Service Record Book No ……On board from …… to …..…..

Total sea service M……D.....

Characteristics	Excellent	Very good	Good	Satisfactory	Unfit
Professional competence and knowledge					
Attitude and conduct					
Intelligence and sobriety					
Performance of duty assignments					
Cooperation with crew and officers					
Cleanliness and personal appearance					

Recommended for promotion: □ Yes, □ No.

If yes, to what position? ……...

If no, explain and indicate what could lead to progress?……..
……
……

Remarks:.……
……
……
……

…….. …… ……
Date Chief Engineer Master

4.3 Inspection by company training officer

Company training officer must confirm and give general assessment of onboard training program completion

Ship name	Company	Comments	Company Training Officer	
			Name	Signature and date

4.4 Inspection by Chief engineer

Chief engineer must confirm onboard training program completion, based on onboard training officer records, shipboard and safety familiarization, ship's particulars, training tasks performance

Ship name	Comments	Chief engineer		
		Name	Signature	Date

4.5 Review by onboard training officer

Onboard training officer comments must represent trainee knowledge, understanding, professional competence, performance of duty assignments and general assessment of training program completion

Ship name	Comments	Onboard training officer (name and position)	Signature	Date

5 Specimen signatures of officers and other experienced staff authorised to sign off tasks, records and reports

All Officers and other personnel, who are authorised to sign off tasks, should enter their details as indicated below. This could include ETO - in which case their qualifications and/or Certificate of Competency details should be included.

No rows should be left blank between entries.

Ship name	Full name (please print)	Position	Certificate grade, number, expiry date, and issuing country	Specimen signature	Specimen initials	Date of entry

Ship name	Full name (please print)	Position	Certificate grade, number, expiry date, and issuing country	Specimen signature	Specimen initials	Date of entry

Ship name	Full name (please print)	Position	Certificate grade, number, expiry date, and issuing country	Specimen signature	Specimen initials	Date of entry

6 Shipboard and safety familiarization

SHIP NAME:	1.		2.		3.	
Task	Officer's signature	Date	Officer's signature	Date	Officer's signature	Date
Undertake a conducted safety tour of the ship						
Demonstrate a knowledge of the ship's emergency plans and procedures						
Demonstrate recognition of the alarm signals for Fire, Emergency and Abandon Ship, and a knowledge of the immediate actions you must take on hearing any of these signals						
Demonstrate a knowledge of the immediate actions you must take if you see fire, smoke, a person fall overboard, or any other emergency occurrence						
Locate your Fire, Emergency and Abandon Ship stations						
Locate your life jacket (or approved immersion suit, where carried) and demonstrate the donning procedure						
Locate all survival craft, lifebuoys, additional lifejackets, immersion suits, personal survival equipment, and any other lifesaving appliances						
Locate the ship's distress rockets, flares and line throwing apparatus						
Locate the portable emergency lifeboat radio, lifeboat radios, EPIRBs and SARTs						
Locate all medical and first aid equipment						
Locate all fire fighting equipment including alarm activating points, alarms, extinguishers, hydrants, fire axes and hoses,						

SHIP NAME:	1.		2.		3.	
Task	Officer's signature	Date	Officer's signature	Date	Officer's signature	Date
breathing apparatus, escape sets, firefighter's outfits, escape routes and other emergency equipment on deck and in the engine room						
Locate all equipment spaces, machinery and controls for sprinkler and drenching systems, and demonstrate recognition of associated alarms						
Locate all equipment spaces, machinery and controls for smothering systems (CO_2 and sprinkler) in engine room spaces, pump rooms, cargo holds and tanks, and any other compartments, and demonstrate recognition of associated alarms						
Locate the emergency fire pumps						
Locate the emergency generators						
Locate all the engine room spaces machinery emergency remote stop switches, valves and other controls						
Locate all the fire, weathertight and watertight doors on the vessel, other than hull openings						
Identify the locations where system drawings and instruction manuals are usually kept for on board equipment and demonstrate an understanding of the procedures to record modifications to them						
Demonstrate a knowledge of security procedures						
Demonstrate a knowledge of waste disposal and pollution prevention procedures						
Demonstrate a knowledge of the location and use of key publications, including the Code Of Safe Working Practices,						

SHIP NAME:	1.		2.		3.	
Task	Officer's signature	Date	Officer's signature	Date	Officer's signature	Date
Emergency Procedures Manuals, Security Procedures manuals, Safety Management System manuals, and Legislation						
Demonstrate an understanding of bridge watchkeeping processes						
Demonstrate an understanding of engine room watchkeeping processes						
Demonstrate an understanding of cargo operations						
Locate all elevators (including passenger elevators on passenger vessels) and identify the safety inspection regime for them and the safety procedures and precautions required to carry out any maintenance or other work activity on them						

7 Ships' particulars

	First ship	Second ship	Third ship
Ship's name			
Ship's type			
Ship delivery year			
IMO Number			
Port of Registry			
Dimension and capacities			
Length Overall, m			
Beam, m			
Depth, m			
Summer draft, m			
Summer freeboard, m			
Net registered, tons			
Gross registered, tons			
Deadweight, tones			
Light displacement, tones			
Loaded displacement, tones			
Service speed, knots			
Steering gear type			
Propulsion plant			
Engine maker			
Number of engines			
Type and building year			
Cylinder bore, m			
Piston stroke, m			
Output, kW			
Speed, rpm			
Engine Fuel:			
type/mark			
consumption, tonnes per day			
specific fuel consumption, g/kW-hr			
viscosity CSt at temperature, °C			
Turbocharger (type, speed)			
Reduction gear type			
Type of propeller			
Power plant			
Number of diesel-generators			
Manufacturers and year of construction			
Engine type			
Cylinder bore, m			
Piston stroke, m			
Output power, kW			
Speed, rpm			

	First ship	Second ship	Third ship
Engine Fuel:			
type/mark			
consumption, tonnes per day			
specific fuel consumption, g/kW-hr			
viscosity CSt at temperature, °C			
Generators:			
number			
type/maker			
voltage, V			
frequency, Hz			
output power, kW			
Electric load at sea / at port, kW			
Shaft generator:			
number			
type/maker			
voltage, V			
frequency, Hz			
output power, kW			
Emergency diesel-generator:			
type/maker			
voltage, V			
frequency, Hz			
output power, kW			
Cargo handling gear and cargo pumps			
Derricks (No. and SWL)			
Cranes (No. and SWL)			
Winches: type, number			
Cargo pumps:			
number			
type/maker			
capacity, tonnes/hour			
Anchors			
Type			
Cable diameter, mm			
Location			
Cable weight, kg			
Lifesaving equipment			
Lifeboats:			
number			
dimensions, m			
capacity per boat, persons			
Life rafts:			

	First ship	Second ship	Third ship
number			
dimensions, m			
capacity per boat, persons			
Davits:			
type			
number			
Lifebuoys: type, number			
type			
number			
Firefighting equipment			
Fire extinguishers:			
Water type			
number			
capacity, litres			
Foam type			
number			
capacity, litres			
Dry powder type			
number			
capacity, litres			
CO_2 type			
number			
capacity, litres			
Fire hoses:			
number			
size, mm			
Breathing apparatus (maker)			
Navigational and communications equipment			
Log			
type/maker			
number			
Radars			
type/maker			
number			
SATCOM			
type/maker			
number			
HF, MF, LF receivers, transmitters			
VHF Radio			
Gyro, Navtex			
type/maker			
number			
Autopilot			

	First ship	Second ship	Third ship
type/maker			
number			
Echosounder			
type/maker			
number			
Ship’s service telephones			
type/maker			
number of subscribers			
Battle telephones			
type/maker			
number of subscribers			
Engine telegraph			
type/maker			
Fire alarm			
type/maker			
number of sensors			
Reviewed by onboard training officer (name and position)			
Signature and Date			

8 Training tasks performance

8.1 Function: Electrical, Electronic and Control Engineering

	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
Task	Position, signature and date	Position, signature and date	Position, signature and date
Competence: Monitor the operation of electrical, electronic and control systems			
Explain the operation of mechanical engineering systems including:			
prime movers, including main propulsion plant			
engine-room auxiliary machinery			
steering systems			
cargo handling systems			
deck machinery			
hotel systems			
Locate and use relevant manuals, drawings, diagrams and instructions			
Locate all electronic control equipment in ship's compartments			
Monitor the operation and parameters of ship’s electrical power system			
Monitor the electrical parameters (power, voltage, frequency, current insulation resistance) using stationary and portable instruments			
Daily check-up of electrical equipment			
Monitor the parameters of electro-hydraulic and electro-			

	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
Task	Position, signature and date	Position, signature and date	Position, signature and date
pneumatic control systems			
Explain the hazards and precautions inherent in operation of power systems above 1000 volts			
Explain the hazards and precautions inherent in explosion hazardous areas			
Competence: Monitor the operation of automatic control systems of propulsion and auxiliary machinery			
Describe operating principle of main engine automatic control system			
Describe operating principle of electronic steering gear control system			
Make ready, start up, check in action and disable following equipment:			
cargo facilities (pumps, windlasses, taps, transporters of loose cargoes)			
steering gear electrical equipment			
autopilot			
navigation and signal lights			
engine room electrical drives			
bow/stern thruster drives and their control systems			
electric drives of lifts, apparels, manhole closings etc. and their control systems			
refrigerator, air-conditioning and refer container electric drives and their control systems			
Competence: Operate generators and distribution systems			
Describe ship's electrical distribution system			
Describe procedure and demonstrate skills in preparing of AC and/or DC generators for starting			

	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
Task	Position, signature and date	Position, signature and date	Position, signature and date
Describe the methods and demonstrate skills of electrical power parameters adjusting			
Describe procedure and demonstrate skills in generator connection to the main switchboard			
Describe procedures and demonstrate skills in taking the generator in parallel operation			
Describe methods and demonstrate skills in load sharing between two generators			
Explain the functions of main switchboard panel devices			
Demonstrate skills in main switchboard consumers switching operations			
Describe the procedure of ship's electrical network connection to shore network			
Explain the purpose of emergency generator and it's operation procedure			
Explain the purpose of ship's batteries			
Competence: Operate and maintain power systems in excess of 1,000 volts			
Describe features of high-voltage systems			
Follow the safety rules while operating high-voltage systems			
Describe ship's high-voltage power plant arrangement			
Competence: Operate computers and computer networks on ships			
Explain shipboard computer network structure and computers use			
Use a bridge-based, engine-room-based and commercial computer in accordance with operator's manuals			
Competence: Use English in written and oral form			
Use English engineering publications, operation manuals and			

Task	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
	Position, signature and date	Position, signature and date	Position, signature and date
fault finding instructions			
List English language publications or manuals used			
Communicate with other crew members in English			
If appropriate, complete company SMS reports in English, for the next:			
generators overhaul			
electric drives overhaul			
Competence: Use internal communication systems			
Describe shipboard internal communication system			
Demonstrate skills in use of shipboard internal communication systems			
Competence: Monitor the operation of bridge navigation equipment and ship communication systems			
List the bridge navigation electrical and electronic equipment and communication systems			
Evaluate condition of bridge navigation equipment and ship communication systems			

8.2 Function: Maintenance and Repair

	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
Task	Position, signature and date	Position, signature and date	Position, signature and date
Competence: Maintenance and repair of electrical and electronic equipment			
Explain the safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment			
Contribute to maintenance and repair of electrical switchboards, motors, generators and equipment:			
generators			
converters			
power transformers			
distribution gears			
electrical contacts of magnetic starter			
lighting equipment			
heating equipment			
batteries			
automation and control devices			
communication devices			
Contribute to technical maintenance of electrical equipment with partial disassembling of:			
AC (DC) electric motor			
magnetic starter (magnetic station), maintenance of electrical contacts			
electromagnetic brake clearance measurement and adjustment			
Contribute to technical maintenance of electrical equipment with complete disassembling of:			
AC (DC) electric motors, bearings lubrication, washing out,			

Task	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
	Position, signature and date	Position, signature and date	Position, signature and date
drying of electric motor after seawater penetration			
magnetic starter			
magnetic station, electric contactors maintenance			
Use of cleaners and washing agents of electrical equipment			
Use of lubricants for bearings			
Competence: Maintenance and repair of automation and control systems of main propulsion and auxiliary machinery			
Indicate the place of electrical propulsion plant manuals			
Describe the procedure of the main generating plant preparation for operation			
Indicate the controlled parameters while the main generating plant in operation			
Describe procedure of running the main power plant out of operation			
Contribute to procedures of technical maintenance of the main generating plant			
Contribute to specifics of maintenance of the main generating plant with voltage more than 1,000 V			
Competence: Maintenance and repair of bridge navigation equipment and ship communication systems			
Explain purpose of each device and it's operation principle			
Enumerate possible defects of equipment			
Contribute to maintenance and repair of bridge navigation equipment			
Contribute to maintenance and repair of ship communication systems			
Competence: Maintenance and repair of electrical, electronic and control systems of deck machinery and cargo handling equipment			
List the procedures and demonstrate skills in the following			

Task	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
	Position, signature and date	Position, signature and date	Position, signature and date
operations:			
detection of equipment malfunction			
replacement of defected equipment, assemblies and parts			
repairing (splicing) or replacement (laying) of electric cable			
replacement of power and auxiliary contacts of contactors			
electric drive alignment			
maintenance of batteries			
Competence: Maintenance and repair of control and safety systems of hotel equipment			
List the electrical and electronic systems of hotel equipment			
Carry out safe maintenance and repair procedures			
Detect the equipment malfunction, locate the faults and provide actions to prevent damage			
Competence: Use ships computer-based maintenance planning systems			
Explain assignment and important functions of computer-based maintenance planning systems			
Contribute to maintenance planning using computer-based maintenance planning systems			

8.3 Function: Controlling the Operation of the Ship and Care for Persons on Board

	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
Task	Position, signature and date	Position, signature and date	Position, signature and date
Competence: Ensure compliance with pollution prevention requirements			
Take actions to prevent pollution			
During relevant drills initiate immediate investigation to detect the source of pollution			
During relevant drills stop or prevent leakages and spills of harmful liquids and solid substances			
Competence: Prevent, control and fight fire on board			
Use fire and smoke detecting equipment			
Contribute to fire drills, use fire-fighting appliances and emergency escape routes and recognize alarm sounds			
Locate fire-stations and demonstrate proper use of fixed installations and other fire-fighting appliances and agents			
Locate and use fire-protection equipment (fireman's outfit, including breathing apparatus)			
Provide safety of persons involved in maintenance of electrical plant			
Competence: Operate life-saving appliances			
Recognize abandon ship drill			
Demonstrate ability to launch a life boat			
Demonstrate ability to launch a life raft			
Demonstrate proper use or radio life-saving appliances, EPIRBs and SARTs			
Ensure that all survival craft launching equipment on board is functioning			

Task	Onboard training officer approval		
	Ship name:	Ship name:	Ship name:
	Position, signature and date	Position, signature and date	Position, signature and date
Competence: Apply medical first aid on board ship			
During relevant drills stop excessive bleeding, ensure breathing and put injured persons in proper position			
During relevant drills detect signs of shock and heat stroke and act according to medical aid recommendations			
During relevant drills, locate and access shipboard medicine and equipment			
Competence: Application of leadership and teamworking skills			
Get acquainted with the established shipboard personnel management and training system			
Communicate effectively on board and ashore			
Contribute to planning the allocation of tasks			
Demonstrate self-management and ability to develop performance of self and team			
Competence: Contribute to the safety of personnel and ship			
Demonstrate of personal survival techniques			
Explain and demonstrate the fire prevention procedures and ability to fight and extinguish fires			
Demonstrate the elementary first aid			
Demonstrate the personal safety and social responsibilities			
Competence: Maintain the operational condition of electrical equipment of the life-saving and other safety systems			
List the electrical equipment of the life-saving and other safety systems			
Contribute to maintenance of electrical equipment of the life-saving and other safety systems			

Annex B Teaching facilities and equipment

Teaching facilities and equipment listed below are recommended for studying the course content. Proposed list of equipment and facilities can be changed or extended by the decision of Training institution. Tutors are free to use additional teaching material (equipment, IMO & regulatory references, textbooks and other aids) that may be best suited for the transference of knowledge and skills to the students (trainees).

A classroom equipped with an overhead projector and a blackboard or interactive or flipchart should be provided for teaching the theory of the course and holding group discussions.

- **Equipment**

  - workbenches for studying: basic laws of electric and magnetic circuits; single-phase and three-phase circuits; linear and nonlinear electric circuits
  - workbenches for studying the conductors, semiconductors, dielectric and magnetic materials
  - A.C. and D.C. electrical machines: generators, motors, transformers
  - low voltage main switchboard with two low power synchronous generators or electric power plant simulator
  - A.C. and D.C. motor starters and speed control systems
  - workbenches for studying the electronic and power electronic elements characteristics
  - electronic and power electronic elements and converters
  - visual aids of ships' hull, propellers and propulsors; general and cargo systems' design diagrams
  - ship equipment and systems arrangement diagrams
  - workbenches for studying the heat transfer, thermodynamic, hydrodynamic processes and force systems
  - ship's engine room main and auxiliary machinery
  - steering gears, rudder propellers, podded and cycloid propulsors; steam and gas turbines, steam boilers
  - components of piping systems, hydraulic and pneumatic systems
  - equipment suitable for use in oil, gas and chemical tankers
  - control and protection equipment of electrical power plants: contactors, relays, time delay relays, thermal relays, over and under voltage relays, switches, circuit breakers, push buttons, control lamps, fuses etc.
  - examples of electrical diagrams
  - lighting fixtures
  - cables and electrical networks
  - lead-acid and alkaline batteries, a charging circuit, distilled water, hydrometer
  - PID control systems or adequate simulator
  - workbench equipped with analog and digital systems for studying the automatic control theory laws and principles
  - electrical propulsion remote-control system simulator
  - programmable logic controllers and programmable automatic controllers
  - electro-hydraulic and electro-pneumatic systems
  - workshops for studying the operation and maintenance of ship hazardous areas electrical equipment
  - measurement equipment: ammeters, voltmeters, power meters, portable multi-meters, insulation testers, oscilloscope
  - temperature, pressure, level and other measurement sensors and converters, temperature and pressure calibrators
  - smart and intelligent transducers

- safety systems; fire-detection systems; flame detection sensors; temperature detection sensors; smoke detection sensors; watch keeping systems; oil detectors; gas detectors; oxygen detectors
- HV apparatus: circuit breaker, transformer, high voltage protection devises, cables, fuses
- HV measurement and control equipment
- computers, local computer networks and programming equipment
- bridge navigation equipment: dynamic positioning system; radars; navigation lights switchboard; radio-locators; logs; ultrasonic depth devices; GMDSS; autopilots
- computer class for English learning
- communication equipment and alarm systems: automatic telephone system; sound powered telephone system; talkback-intercom system; public address system; UHF internal communication system
- workshop with diagnostic and measuring equipment
- computers with vessel management software installed
- electrical engineering workshop for the training in the following types of work: hand tools, machine tools, cable works, soldering, electric equipment testing
- marine pollution prevention equipment
- training class with fire-fighting equipment
- training class with life-saving equipment
- medical class

- **IMO & regulatory references**

1. International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978, as amended (2011 Edition), IMO
2. lnternational Conventlon for the Safety of Life at Sea, 1974, as amended (SOLAS), IMO
3. lnternational Convention for the Prevention of Pollution from Ships. 1973/78. (MARPOL), Consolidated Edition, 2006, IMO
4. International Standard Classification of Education (ISCED), 2011, UNESCO
5. International Electrotechnical Comission Standards (IEC)
6. Maritime Labour Convention (MLC), 2006, ILO
7. lnternational Life Saving Appliance Code (LSA Code), 2010, IMO
8. International Safety Management (ISM) Code and Guidelines on the Implementation of the ISM Code (2010 Edition), IMO
9. International Ship and Port Facility Security Code (ISPS Code), 2003, IMO
10. International code for the construction and equipment of ships carrying dangerous chemicals in bulk (IBC Code), London IMO
11. International code for the construction and equipment of ships carrying liquefied gases in bulk (IGC Code), London IMO
12. lnternational Code for Fire Safety Systems (FSS Code), 2007, IMO
13. International Code for Application of Fire Test Procedures (FTP Code), 1998, IMO
14. Graphical symbols for fire control plans, 2006, IMO
15. MSC Circular 1014: Guidelines on Fatigue Mitigation and Management
16. MSC Res A 890(21) & Res A 955(23): Principles of Safe Manning & Amendments
17. Quality Management Systems ISO 9001:2008
18. Environmental Management Systems ISO 9001:2008
19. Risk Management ISO 31000:2009

- **Textbooks**

1. Ådnanes A.K., Maritime electrical installations and diesel electric propulsion, Tutorial, Report/Textbook, ABB Marine AS, Oslo, Norway, 2003
2. Advanced DC/DC converters / Fang Lin Luo and Hong Ye. - CRC Press LLC, 2004 - 762 p.
3. Advanced Electrical Drives: Analysis, Modeling, Control / Rik De Doncker , Duco W.J. Pulle , Andre Veltman, - Springer Science+Business Media BV, 2011. -455p.

4. Analysis of Electric Machinery and Drive Systems. Second Edition / Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Purdue University, - IEEE Press, 2002. - 632 p.
5. Ashish Tewari. Modern Control Design with MATLAB and SIMULINK, -John Wiley & Sons, Inc., - 2002. - 503 p.
6. Austin Hughes. Electric Motors and Drives Fundamentals, Types and Applications. Third edition, - Newnes is an imprint of Elsevier, 2006. - 410 p.
7. Axelson Jan, The microcontroller idea book: circuits, programs, & applications featuring, Lakeview Research, USA; ISBN 0-9650819-0-7
8. Barry W Williams Principles and Elements of POWER ELECTRONICS: Devices, Drivers, Applications, and Passive Components. - Glasgow, 2006. – 1432 p.
9. Barnes M., Practical variable speed drives and power electronics, Elsevier, 2003
10. Bass, B.M. (1990) Bass and Stodgill's Handbook of Leadership. Third Edition. London: The Free Press
11. Berger H., Automating with STEP 7 in LAD and FBD: Simatic S7-300/400, SIEMENS
12. Berger H., Programmable Controllers in STEP 7 Basic with SIMATIC S7-1200, SIEMENS
13. Bimal K. Bose. Power Electronics and Motor Drives. Advances and Trends. -Academic Press is an imprint of Elsevier, 2006. - 917 p.
14. Bird J., Electrical circuit theory and technology, Elsevier 2002
15. B. Jayant Baliga. Fundamentals of Power Semiconductor Devices. - Springer Science + Business Media, LLC, 2008. - 1069 p.
16. Blakey T.N., English for maritime studies. 2nd ed., Hemel Hempstead, Prentice Hall International (UK) Ltd, 1987 (ISBN 0 13 281379-3)
17. Bolton W., Programmable Logic Controllers, NEWNES: ISBN: 978-0750681124
18. Bose B. K., Power electronics and motor drives - advances and trends, Elsevier, 2006
19. Cadick J., Electrical safety in marine environment. Cadick Corporation, Technical Bulletin 010, January 2001
20. Cadick J. et al, Electrical safety handbook, Third Edition, Mc Graw Hill 2005
21. Computer data, including: Data Set, Electronical Data Interchange, Random Access, Computer Data Processing, Text File, Binary Code,… by Hephaestus Books
22. Drucker, P.F. (1968) The Practice of Management. London. William Heinemann
23. Elevator industry field employees' safety handbook, 2010
24. Electrical Engineering: Tables, Standards, Formulas. 1st English Edition. Europa -Technical Book Series for the electrotechnical, electronic and information technology trades. Europa no 30337. -456 p.
25. Ellis Norman., Electrical interference handbook, Second edition, Publisher: NEWNES, ISBN-10: 9780750635479
26. Fardo S.W, Patric D.R., Electrical power systems technology, The Fairmont Press, Lilburn 2009
27. Fossen T., Marine control systems, Marine Cybernetics, Trondheim 2002
28. Górski Z., Construction and operation of marine cleaning machinery. Trademar. Gdynia 2009
29. Górski Z., Construction and operation of marine hydraulic machinery. Trademar. Gdynia 2008
30. Górski Z., Construction and operation of marine pumps. Trademar. Gdynia 2010
31. Górski Z., Construction and operation of marine steering gears, controllable pitch propellers and stern tubes. Trademar. Gdynia 2009
32. Górski Z., Construction and working of marine compressors, blowers and fans. Fundacja Rozwoju Akademii Morskiej w Gdyni. Gdynia 2006
33. Górski Z., Construction and working of marine heat exchangers. Fundacja Rozwoju Akademii Morskiej w Gdyni. Gdynia 2007
34. Grech, Horberry, Koester (2008) Human Factors in the Maritime Domain. London, CRC Press
35. Grint, K. (2005) Leadership: Limits and Possibilities. Basingstoke, Palgrave Macmillan
36. Gross Ch. A., Electric machines, CRC Press Tylor & Francis Group, Boca Raton, FL, 2007
37. Guidance Notes on Control of Harmonics in Electrical Power Systems, -American Bureau of Shipping, 2006. - 222 p.
38. Gunnar Fahlgren (2011) Human Factors. Bloomington, AuthorHouse

39. H. Wayne Beaty Handbook of Electric Power Calculations. Third Edition. -MCGRAW-HILL, John Wiley & Sons, Inc., - London, - 2009. - 553 p.
40. Hall D. T., Practical marine electrical knowledge, London, Witherby & Co Ltd, 1999
41. Handy, C.B. (1993) Understanding Organisations. London, Penguin
42. Hannah－Hillier, J., Applied mechanics. Harlow, Longman 1995. (ISBN 0582 25632.1)
43. Hellerman H., Digital computer system principles
44. Horovitz P., Hill W., The art of electronics, Cambridge University Press, 1989
45. http://safety.elevatorworld.com/handbook.htm
46. Huber M., Tanker operations, a handbook for the Person-in-Charge (PIC), Cornell Maritime Press, Centreville, Maryland, 2001
47. Hubert C. I., Triebel W. A., Operation, testing and preventive maintenance of electrical power apparatus, Prentice Hall 2002
48. IACS Guidelines and Recommendations No.35 Inspection and maintenance of electrical equipment installed in hazardous areas
49. ICF, OCIMF & IAPH, International safety guide for oil tankers and terminals (ISGOTT). 5th ed. London, Witherby & Co. Ltd., 2006 (ISBN 1-85609-291-7)
50. Induction Motor Control Design/Riccardo Marino, Patrizio Tomei, Cristiano M. Verrelli, - Springer-Verlag London Limited, 2010. - 350 p.
51. International Chamber of Shipping (ICS): Tanker safety guide (Liquefied Gas), London, Whiterby & Co. Ltd. 1978.
52. Irving M. Gottlieb Practical Electric Motor Handbook, Newnes, 1997. - 173 p.
53. Jackson L., Instrumentation and control systems, Thomas Reed Publications Ltd.1992
54. Jackson L. and Morton T.D., General engineering knowledge for marine engineers. 5th ed. London, Thomas Reed Publications Ltd 1990. (ISBN 0947 637.761)
55. Janusz Mindykowsky. Assessment of Electric Power Quality in Ship Systems Fitted with Converter Subsystems. Polish Academy of Sciences Electrical Engineering Committee. Book Series: “Advances of Electrical Drivers and Power electronics”. Shipbuilding & Shipping 2003.- 265 p.
56. Jeffery, R (2007) Leadership Throughout. London: The Nautical Institute
57. Joel, R., Basic engineering thermodynamics in SI units. 4th ed. Harlow, Longman, 1996 (ISBN 0582 41626 4)
58. Kasap S., Principles of electronic materials and devices, Third Edition, McGraw-Hill, 2006
59. Kaźmierkowski M.P, Tunia H., Automatic control of converter-fed drives, Elsevier 1994
60. Khanna Vinod Kumar., The insulated gate bipolar transistor: IGBT theory and design, A John Wiley & Sons, INC., Publication; ISBN 0-470-23845-7
61. Kiameh Philip., Electrical equipment handbook: troubleshooting and maintenance, McGraw-Hill Professional; ISBN: 978-0071396035
62. Kossowski K., Introduction to the theory of marine turbines. Foundation for the Promotion of Marine Industry. Gdańsk 2005
63. Kossowski K., Ship Turbine Power Plants. Foundation for the Promotion of Marine Industry. Gdańsk 2005
64. Kothari D. P., Nagrath I. J., Electric machines, Mac-Graw-Hill, New Delhi, 2006
65. Kotter, J. (1990) A Force for Change: How Leadership Differs from Management. New York, The Free Press
66. Kraal E.G.R., Basic electrotechnology for engineers, 3rd Edition, Thomas Reed Publications Ltd.1985
67. Kuffel E., Zaengl W. S, Kuffel J., High voltage engineering, fundamentals, Second edition, Elsevier Ltd., 2000
68. Kwaśniewski J., Programmable Logic Controllers, Published by WIMiR AGH, Kraków, 2002
69. Lipo T. A., Jezernik K., AC Motor speed control, University of Wisconsin, Madison WI, U.S.A, University of Maribor, Maribor, Slovenia, 2002
70. Lister Eugene, Rusch Robert, Electric circuits and machines, McGraw-Hill, ISBN: 9780028018096
71. Love J., Process automation handbook, Springer 2007

72. Mackay S., Wright E., Reynders D., Practical industrial data networks: design, installation and troubleshooting, Elsevier 2004
73. Maini Anil K., Digital electronics: principles, devices and applications, Wiley; ISBN: 978-0470032145
74. Malcolm Barnes. Practical Variable Speed Drives and Power Electronics, -IDC Technologies, 2003. - 286 p.
75. Manual for use by the maritime mobile and maritime mobile-satellite services, ITU Geneva 2011
76. Marine Control Systems. Propulsion and Motion Control of Ships and Ocean Structure. Lecture Notes. Asgeir J. Sorensen. Department of Marine Technology Norwegian University of Science and Technology. 2012.- 535 p.
77. Maritime & Coastguard Agency (MCA) UK (2010) The Human Element: A Guide to the Human Behaviour in the Shipping Industry. London, The Stationery Office
78. Mc George H.D., Marine electrical equipment and practice, Butterworth-Heinemann, Oxford 2004
79. Mc Ghee J., Henderson J. A., Korczyński J., Kulesza W., Scientific metrology, Lodart S.A., Łódź, 1996
80. Mc Guire and White, Liquefied gas handling principles, London, Whiterby Marine Publishing 1978
81. Michalski L., Eckersdorf K., McGhee J., Temperature measurement, John Wiley & Sons, New York
82. Milton J. H., Leach R.M., Marine steam boilers. Butterworth Marine Engineering Series. London – Boston 1980
83. Mohan N., First course on power electronics and drives, NMPERE Minneapolis 2003
84. Mohan N., Undeland T., Robbins W., Power electronics converters, applications and design, Third Edition, John Wiley, 2003, ISBN: 978-0-471-22693-2
85. Moon, J. A. (2002) Reflection in Learning and Development. London, Kogan Page
86. Morris A. S., Measurement & instrumentation principles, Butterworth- Heinemann, 3rd edition 2001
87. Muhammad H. Rashid. Power Electronics Handbook. Second Edition, -Academic Press, 2007. - 1172 p.
88. Norman S. Nise. Control Systems Engineering. Sixth Edition, - John Wiley & Sons, Inc.,- 2011.-928 p.
89. Oil Companies International Marine Forum. Mooring equipment guidelines. London, Witherby 1997
90. Pearce Durrance J. G., Sound-powered telephone talkers' training manual NAVEDTRA 14232, Published by Naval Education and Training Professional Development and Technology Centre NAVSUP 1994
91. Peek F. W., Dielectric phenomena in high voltage engineering, Watchmaker Publishing 2006
92. Perez T., Ship motion control, Springer Verlag, London 2005
93. Peter Vas. Sensorless Vector and Direct Torque Control, Oxford University Press,1998.-729 p
94. Power Electronics. Daniel W. Hart. - Valparaiso University Valparaiso, Indiana, McGraw-Hill Companies, Inc. - 2011. - 477 p.
95. Power Electronics Design Handbook: Low-Power Components and Applications / Nihal Kularatna. - Newnes. 1998. - 300 p.
96. Power Electronics Handbook / Fraidoon Mazda .Third edition - Newnes, printed and bound in Great Britain by Antony Rowe Ltd, Eastbourne, 1997. – 450 p.
97. Power Transformers Principles and Applications / John J., Winders, Jr. PPL Electric Utilities Allentown, Pennsylvania. Marcel Dekker, Inc., - 2002. -286 p.
98. Properties of gases and liquids, LGA Gastechnik GmbH, 1985.
99. Randall Shaffer. Fundamentals of Power Electronics with MATLAB, - Charles River Media, - 2007. - 384 p.
100. Reason, J. (1990) Human Error. New York, Cambridge University Press
101. Reason, J. (1997) Managing the risks of organizational accidents. Aldershot, Ashgate

102. REED's Volume 6: Basic electrotechnology for engineers; E. G. R. Kraal, Publisher: London: Thomas Reed Publications, [1985] ISBN: 0900335963
103. REED's Volume 7: Advanced electrotechnology for engineers. 2nd Ed., KRAAL, E.G.R. London, Adlard Coles Nautical, 2008
104. REED's Volume 10: Instrumentation and control systems (REED's Marine Engineering Series) Leslie Jackson; Publisher: Thomas Reed Publications, ISBN: 0947637869 Edition: Paperback; 2002-12-07
105. Reynders D., Mackay S., Wright E., Practical industrial data communications: best practice techniques, Elsevier 2005
106. Reynders D., Wright E., Practical TCP/IP and Ethernet networking, Elsevier 2003
107. Roberts P. (Capt), Watchkeeping safety and cargo management in port. London, The Nautical Institute, 1995 (ISBN-10: 1-870077-29-6)
108. Roy G. J., Notes on instrumentation and control, London Stanford Maritime Ltd. 1985
109. Seung-Ki Sul Control of Electric Machine Drive Systems, - IEEE Press, 2011.-401 p.
110. Shapiro H., Cranes and derricks. United States of America: McGraw-Hill, 1980
111. Sherman E., Advanced marine electrics and electronics troubleshooting: a manual for boat owners and marine technician, International Marine 2007
112. Sherman E., Powerboater's Guide to electrical systems: maintenance, troubleshooting, and improvements, International Marine 2000
113. Ship Knowledge, a modern encyclopedia. Rudolf Das, Robbert Das, 2001.- 376p. (www.dokmar.com)
114. Sidney Dekker (2007) Just Culture: Balancing Safety and Accountability. Aldershot, Ashgate
115. Smith R. G., Application of automatic machinery and alarm equipment in ships, Institute of Marine Engineers; ISBN: 0900976152
116. Stephen J. Chapman Instructor's Manual to accompany Electric Machinery Fundamentals. Fourth Edition, - McGraw-Hill, Inc., 2004. - 324 p.
117. Strauss C., Practical electrical network automation and communication systems, Elsevier 2003
118. Sueker, Keith H. Power electronics design: a practitioner's guide / by Keith H. Sueker. - 1st ed., - Newnes is an imprint of Elsevier, 2005. - 272 p.
119. Switching Power Supply Design. Third Edition /Abraham I. Pressman, Keith Billings, Taylor Morey. - McGraw-Hill Companies, 2009. - 841 p.
120. Taylor, D.A. (Dr.), Merchant Ship Construction, 4th ed. London, Institute of Marine Engineers, 1998 (ISBN 0-408-01535-7)
121. Taylor D. A. and Billis, Marine control practice, Butterworth-Heinemann; ISBN: 978-0408013130
122. Tetley L., Calcutt D., Electronic navigation systems. Elsevier, London 2001
123. The Industrial Electronics Handbook. Second Edition. Power electronics and motor drives. Edited by Bogdan M. Wilamowski, J. David Irwin, - CRC Press Taylor & Francis Group, LLC, - 2011. - 974 p.
124. Thompson L. M., Industrial data communications, 4th Edition, ISA 2008
125. Tokheim Roger L., Digital electronics: principles and application, McGraw-Hill, ISBN: 978-0078309823
126. Van Der Horn Gert, Huijsing Johan H., Integrated smart sensors: design and calibration, Kulwer Academic Publishers, 3300 AA Dordrecht, The Netherlands; ISBN 0-7923-8004-5
127. Various technical documentation of ship electrical devices and systems
128. Wackerly J. F., Digital design principles & practices
129. Walsh P.P., Flether P., Gas turbine performance. Blackwell Publishing. Oxford 2004
130. Watson G. O., Marine electrical practice, Butterworth-Heinemann 1991
131. Western, S. (2008) Leadership: A Critical Test. London, Sage
132. Wharton A.J., Diesel engines. Butterworth Heineman. London 1991
133. Whitaker J. C., Electronic systems maintenance handbook, Technical Press Morgan Hill, California, USA, 2002
134. Whitaker J. C., The resource handbook of electronics, Technical Press Morgan Hill, California, USA, 2001
135. Zachariason R., Electrical materials, Thomson, Delmar Learning, 2007

International Association of Maritime Universities

Toranomon 35 Mori Building 7F, 3-4-10 Toranomon, Minato-ku, Tokyo 105-0001, Japan

Tel : 81-3-5408-9012 E-mail : info@iamu-edu.org URL : http://www.iamu-edu.org

ISBN978-4-907408-00-8