

SYSTEM OF EDUCATION OF MARINE ENGINEERING FACULTY OF GDYNIA MARITIME UNIVERSITY

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Abstract

The paper presents the system of evaluation of education currently in force in Poland. In order to standardize the quality of education in all the courses and in all of the higher education institutions the State Accreditation Committee was founded in the present form in 2002. There were prepared criteria that include the issues associated to assuring the adequate conditions of studying as far as the didactic base is concerned, teaching staff, didactic programmes (included the fulfilling the basic programme minimum), organization of the didactic process, etc. The Maritime University of Gdynia educates and trains the specialist for working at sea. Thus far, the didactic system must meet the requirements not only of the SAC (typical for a technical university) but also of the STCW convention that imposes adequate requirements as far as the subjects, number of hours, periods and subjects of practical training, etc. is concerned. For the graduates that will work at sea, the problems of meeting criteria of education were presented taking Faculty of Marine Engineering of the Maritime University of Gdynia as an example the, which prepares students in the course of Mechanics and Machine Building and prepares graduates for the work at sea as mechanic officer of merchant marine. The paper presents Medium Speed Engine Room Full Mission Simulator. The simulator has been developed based on cutting-edge solutions currently used in medium-sized, computer controlled engine rooms (one four-stroke type main engine with a reduction gear and controllable pitch propeller). This kind of computer controlled engine room is typically in use on modern container ships.

Keywords: *system of evaluation of education, Maritime University of Gdynia, Engine Room Simulator*

1. Introduction

In order to standardize the quality of education of all university courses and in all higher education institutions in Poland, the State Accreditation Committee (SAC) was founded (1, 2). The SAC was brought into existence on 1 of January of 2002 by a parliament's bill. The area of operation of the SAC is all the private and national higher education establishments that exist on the basis of that bill. The SAC works for the quality of education and its aims and course of action are defined by the bill. Unlike it is the case with professional commissions, every higher education institution is obliged to submit itself to the SAC's examination. A negative result of such examination may lead the minister responsible for the higher education to take a decision of withdrawing or suspending the right to educate students in a specified course or level of education.

The purpose of the SAC is the control of regularity of realization of the didactic process and meeting criteria developed for each course for the existing universities and fulfilling standards for the faculties which want to open a new course. The standards of education comprehend the issues linked to adequate studying conditions as far as the didactic base is concerned, adequately qualified teaching staff, didactic programmes (included the fulfilling of programme minima), profile of the graduate student, practical training, organization of the didactic process and meeting the international standards of education. If the studies are two-tier, which will be obligatory next year in Mechanics and Machine Building, all the elements of standards of education are defined for each level of studies in a common document (4).

2. General requirements of running studies in an academic course

A faculty can run engineering studies if:

- educational idea is coherent, that is, the purposes of education and the qualifications of the graduate student are established as well as the plans and programmes of studies are compatible with the standards of education,
- the minimum staff requirements are fulfilled, that is, the adequate number of professors of adequate qualifications is employed,
- the faculty has an adequate infrastructure that enables an adequate level of realization of purposes of education,
- the faculty ensures the access to a library recommended for education at the given course,
- secure the students for having the practical training required in the standards.

The Faculty may run the second step studies if it carries out a scientific investigation in the area linked to the course.

The minimum staff requirements differ in relation to the course (3). For the engineering studies there is a necessity to employ three teachers with the title of professor and university degree of doctor habilitated, included at least two professors that have scientific output in the area of the course and at least one with the output in an approximate area. Moreover, there is a requirement of employing at least six academic teachers with the degree of doctor, included at least five of scientific output in the area of the course and at least one with the scientific output in an approximate area.

For the second step studies the required minimum is at least six academic teachers with the degree of professor or the degree of doctor habilitated, with at least five staff members with scientific output in the course subject and at least one with the scientific output in the approximate area. Moreover, there is a requirement of employing at least six academic teachers with the degree of doctor, including at least four of scientific output in the course subject and at least two with the scientific output in the area approximate to the course.

The presented minima of staff requirements are currently in force. Last year the requirements of staff minimum for the second step studies were modified and the number of independent research academics was decreased from eight to six and the permission was given to include, for the obligatory staff, the retired professors on condition that they are full-time professors. This decision was taken as a result of pressure from private universities lobby for which meeting staff criteria was difficult and the activities of the SAC became more intensive.

For each course the programme minima were developed, which include global number of hours for the whole period of studies, and for the general and primary subjects there was imposed a number of hours and the contents demanded.

The standards of teaching for the courses are a collection of requirements referred to the programme of studies and its realization together with the list of general and primary subjects as well as the programme contents and the minimal number of hours that is obligatory for each course.

The engineering studies last at least seven semesters and are completed with acquiring the professional title of engineer.

The subjects of education were divided in three basic groups: general, primary and specialized. For each group of subject the number of hours was imposed but for the general subject the minimal number of hours was stipulated (Tab. 1, 2).

Moreover, the programmes should include the subjects relating to the protection of intellectual property, as well as security of work and ergonomics. At least 50 % of lessons should be individual, i.e. practical lessons, laboratories, seminars, projects. Also 50 % of lessons should include technical content.

The second level studies last at least three semesters and the graduate receives the M.Sc. title.

Tab. 1. Programme criteria for the first step studies

	Hours.	ECTS
GLOBAL NUMBER OF HOURS	2400	210
BASIC PROGRAMME CONTENTS	345	35
Mathematics	120	
Physics	60	
Technical Mechanics, Strength of materials, Fluid mechanics	165	
COURSE PROGRAMME CONTENTS	615	60
Fundamentals of machine elements design		
Material engineering		
Processing of materials		
Thermodynamics		
Electrotechnics and electronics		
Automations and robotics		
Metrology and measuring systems		
Management of environment and ecology		
PRACTICAL TRAINING	4 weeks.	
ADDITIONAL SUBJECTS	270	12
Humanistic	60	3
Foreign language	120	5
Information technologies	30	2
Physical culture	60	2
THESIS	-	15

For the general subjects the number of hours demanded was imposed and in the range of primary subjects the global number of hours demanded was specified and its division was left for the faculties according to the specialities realized.

The programmes of studies must be designed in a way that makes it possible to prepare an adequate profile of a graduate student. The profile of the graduate defines in a compact manner the goals of the educational process in every defined level of studies (included the studies on the secondary level and preparing for the research work) as well as the range of knowledge in the specialization and the possibility of employing the graduate. In the case of professional studies it also defines potential competence that can be acquired by the graduate and his possibilities on the work market.

3. Course of accreditation

The team that evaluates a course in a faculty is appointed by the president of the SAC. The commission comprises of a chairman (who is a member of the SAC), two experts (specialized in the area to evaluate, i.e. Mechanics and Machine Building), a representative of Ministry of Science

and Higher Education to verify legal compliance of the didactic process and a representative of the students' Parliament. The SAC's accreditation is obligatory. The Faculty appointed to the accreditation prepares an autoevaluation report according to a pattern in which it exposes in an abbreviated form:

- data about the University, Faculty and the course due to evaluate,
- staff that executes the didactic process in the course and included in the staff minimum requirements,
- fulfilling the standards of educations,
- didactic base, laboratories, library,
- social conditions for students,
- scientific investigation and international cooperation,
- extraordinary achievements.

Tab. 2. Programme criteria for the second step studies

	Hours	ECTS
GLOBAL NUMBER OF HOURS	900	90
BASIC SUBJECTS	30	3
Analytic mechanics	30	3
PRIMARY SUBJECTS	120	12
Computer Aid Design		
Contemporary engineering materials		
Computer integrated manufacturing		
PROJECT	90	9
M.Sc. thesis	-	20

The autoevaluation report is sent to the members of the commission before the accreditation to a primary evaluation of the realization of didactics and fulfilling criteria in the course. Next, the team visits the Faculty and verifies the state of realization of didactics in the course. In the visitation, first there is a meeting with the Rector, next with Dean and the team that has prepared the autoevaluation report. In this moment the issues related to the report are discussed. Next, the commission visits lessons, laboratories, class-rooms, and the library. The activities of the dean's office are also evaluated as far as the quality of service for the students is concerned. The level of M.Sc. thesis is evaluated at random, and the correctness of M.Sc. exams, procedures of students' questionnaires and realization of the conclusions driven out of them. The social base, the recreative and sport complexes for the students are evaluated. During the meetings with students and academic staff didactic process execution, problems in the educational process, etc are discussed. At the end of the visitation, the SAC's team meets the management of the Faculty and refers the negative and positive considerations without giving any mark. The mark is worked out by the technical commission of SAC on the basis of the report and explication of the chairman of the team. SAC can give one of three following grades:

- positive – gives the right to realize the education for 5 years,
- conditional – gives the right to realize didactics in a determinate time that should be approved to eliminate the faults,
- negative – closing the course by discontinuing the recruitment.

4. Course of accreditation

Maritime University of Gdynia educates and prepares specialist personnel for the work at sea. Therefore, the didactic system must meet the SAC requirements (typical for a technical university) but also those of the international convention STCW (Poland is its signatory), which imposes adequate requirements as far as the subjects, number of hours, period, subjects of practical training, etc. is concerned, for those graduates who will work at sea. Until now, the studies in the Maritime University were uniform and used to finish with M.Sc. diploma (5). The studies last 5 years and the eighth semester are dedicated to individual maritime practice training. The graduates of the Faculty that study at sea courses gain the right to work at sea in the operational range of exploitation of the marine power plants (Tab. 3). It gives them possibility of professional promotion, including the highest professional ranks in the machine compartment of a ship without any necessity of additional professional training after completing the adequate number of hours at sea. As a consequence, it is necessary to include 6 months of sea practical training in the programmes. The training is conducted at the Academy's sail ship „Dar Młodzieży” – 4 to 6 weeks and during the individual sea practical training on the ships of different ship-owners in the range of at least 5-6 months. According to the STCW convention, each student has an individual practice training register in which there are estipulated the subjects to be realized during the practical training as well as the confirmations by the chief of the ship's compartment of the grade of mastership of each issue.

Tab. 3. Programme criteria for the courses in GMU

	FIRST STEP STUDIES	SECOND STEP STUDIES
Global number of hours	2400	900
Standards of Ministry of Science and Higher Education	1210	240
Rest	1190	660
STCW Standards	732	598

The STCW standards (6) refer mainly to the primary and specialized subjects and the subject required are the same as those according to the standards of the Ministry of Science and Higher Education. The summary number of hours in the two-tier studies is 3300, while until now, in the M.Sc. courses it was 3750 hours. The Marine Engineering Faculty of Gdynia Maritime University is presently modifying the programmes because of the introducing the new two-tier system of education. The total number of hours will be 3500, and in the engineering studies 2500. The graduates of the engineering studies will be entitled to work at sea in the operational range and those of the second level - in the range of management.

In 2009 the Marine Engineering Faculty of Gdynia Maritime University was accredited by the SAC and by EMSA, Maritime Administration in the aspect of meeting the STCW convention requirements. Both accreditations were completed with a positive result and the Faculty received the right to concede the rights to work at sea on the level of management. The staff of the Faculty, good base of laboratories that includes a range of exploitation and didactic simulators ensures a high level of education of officer mechanics of merchant fleet. The level of education is illustrated in the best way by the fact that all the graduates find work on the ships of different flags. A great number of students after finishing their individual practice training receive from the ship owners a proposal of scholarship.

At the Marine Engineering Faculty work 82 teachers appointed by nomination (Tab. 4). The requirements of the STCW specify that experienced officer's mechanics of the highest ranks should take part in the didactic process of the future officers. That is why the Faculty employs 6

academic teachers that hold the rank of the first ship mechanic and 4 of them are Ph.D. and have Professor degree. The development of the staff is made not only in the scientific area but also in the area of sea ranks.

Presently, the minimum staff includes 4 academic teachers with a Ph.D. degree and the highest sea rank that is Marine Chief Engineer.

The staff minimum can include academic teachers with or without the scientific degree that specialize in the discipline Mechanics and Machine Building, are employed in the full-time regime, with the number of teaching hours that does not exceed 60.

Tab. 4. Academics of the Faculty

Qualifications	Nominated
Professor with the scientific title	4
Doctors habilitated	8
Professors with the Dr degree (Chief of engines)	4
Doctors	30
Rest	36
General	82

Approximately 1000 students study in the Marine Engineering Faculty (600 in the stationary studies).

One of the evaluation criteria is the number of academic teachers that take part in the didactic process and account for the staff minimum per number of students.

The ratio of the didactic staff that accounts for the staff minimum and students is $40/1000 = 1/25$, which exceeds the minimum recommended by the SAC. (1/80).

The Faculty has a very well prepared didactic base. The didactic base includes auditoria and class-rooms equipped with the material to support the didactics, that is, multimedia projectors, specialized software, etc. The laboratories are equipped very well. In the laboratories the students have the possibility to work with real equipment and with the simulators. The laboratory and simulator classes account for 40 % of all classes in the sea major. All the laboratories have specialized equipment conforming to international standards. The Faculty has a laboratory of the marine power plant equipped with working engines of the main propulsion and auxiliary propulsion, auxiliary mechanisms, refrigerators, etc. According to the STCW requirements, a large portion of classes should be conducted with the use of simulators. The Faculty has three simulators: simulator of exploitation of marine power plants, simulator of diagnostics of combustion engine and a simulator of cargo operations on the ships for transport of condensed gas – all of them work with unique software made by our professors.

In the didactic process also two school's ships (sail ship DAR MŁODZIEŻY and HORYZONT II) equipped with the machines of the newest generation are used.

Tab. 5. The most important laboratories of the Faculty

N°	Name of laboratory
1.	laboratory of marine internal combustion, mechanisms and auxiliary machines, refrigeration
2.	simulator of a marine power plant
3.	simulator of the cargo operation of LPG vessel
4.	simulator of engine diagnostics
5.	laboratory of fundamentals of machine exploitation
6.	Mechanic workshop

5. Room Full Mission Simulator

Medium Speed Engine Room Full Mission Simulator consists of three main parts:

- Engine Control Room ECR with main engine control console and main electric switchboard,
- Engine Room with two PC projectors and control console for 3D visualization combined with diagram presentation,
- Instructor Room.

The simulator has been developed based on cutting-edge solutions currently used in medium-sized, computer controlled engine rooms (one four-stroke type main engine with a reduction gear and controllable pitch propeller). This kind of computer controlled engine room is typically in use on modern container ships.

Virtual reality simulator offers a new approach to navigation because the elements of the system allow for an easy and quick access to basic engine room functions (valve opening/closing, setting position of switches, push-buttons etc.). This is possible due the application of state-of-the art 3D visualisation with zoom techniques. The latest developments also include a combination of 3D and 2D diagram presentation, which allows for monitoring the actual functions of a certain device and collecting comprehensive information on its structure.

The simulator serves as practical preparation of a trainee for engine room operation, particularly in terms of:

- familiarization with basic engine room systems (compressed air system, fresh and sea water cooling system, lubricating, fuel oil system etc.), with special attention paid to training in a modern, computer controlled engine room,
- acquiring main engine and auxiliary equipment exploitation procedures,
- propulsion system manoeuvring (main engine - reduction gear - CPP).



Fig. 1. Control consoles and Electric Switchboard panels

In the case of the main engine the starting and stopping procedures are executed on hardware type control consoles and Electric Switchboard panels (Fig. 1).

Basic auxiliary sub-system operations involve mouse-clicking on the PC screen, just like it is done on real modern ships. Diagrams related to specific systems like fuel oil, compressed air system, cooling system, lubricating system, steam system, etc. are presented on the PC screen. For security reasons the Engine Control Room is equipped with two identical PCs with monitors. In case one PC should fail, the second one takes over automatically. Clicking on the appropriate parts of the screen can start/stop the pumps or compressors, and open/close the valves, which are remote controlled.

One screen presents a 3D visualization of engine room elements and another one presents the elements in a diagram illustrating specific and selected compartments of engine rooms (Fig. 2), for

example auxiliary generator room, emergency generator room (Fig. 2), compressed system room etc. Engine room elements that are important in terms of exploitation are selected by means of zoom techniques.

In the efforts to improve the efficiency of the didactic process, the Faculty obtained ISO 2001 certificate for the didactic procedure. The forms of evaluation of didactic process conform to the ISO norms. The system of lesson appraisal by students was introduced in 2001 in the Faculty. The basis for the appraisal is an anonymous questionnaire, and each active academic teacher is evaluated in this way at least once a year. The results of the questionnaire are discussed in the Faculty Council. The chairman of each department receives detailed information about the evaluation of their teachers and the teachers are informed about the evaluation of their classes.



Fig. 2. Engine rooms and emergency generator's room

A graduate of the Marine Engineering Faculty of Gdynia Maritime University has three characteristics that essentially make a good employee: knowledge, skill and professional profile. The adequate level of these characteristics is guaranteed thanks to the Certificate of Quality for the didactic process conforming to PN – ISO 9001, which the Faculty has been awarded with. A graduate of EXPLOITATION OF MARINE POWER PLANTS has general education and the essential skills acquired in the didactic programme for the “Mechanics and machine building” course, which gives him comprehensive preparation for the profession of engineer mechanic. Moreover, he has the competence and skills relating to marine power plant exploitation which offer him sufficient qualifications for the position of an officer in sea ships and open the opportunities for career development and promotion to the highest professional ranks without completing additional courses. In this respect the didactic programmes perfectly comply with the STCW convention requirements. The graduates that cannot work at sea are prepared to work in for ship owners, shipyards, classification associations and the best of them in the higher education entities.

6. Conclusions

The central system of evaluation and monitoring of the level of education functions well. It promotes the process of standardization of the education at different universities. It eliminates weak universities, which were established as a result of the political system transformation and which profit-oriented and did not focus on the quality of education. The paper presented the accreditation procedures taking the Gdynia Maritime University as an example. This university scored high marks not only during the SCA accreditation, but also during the accreditations performed by Maritime Institutions (EMSA) that supervise the quality of education of the future mechanics of merchant fleet.

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