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Marine engineering curriculum in the Philippines - an analysis

Menelieto Alano Olanda
WMU

WORLD MARITIME UNIVERSITY
Malmoe Sweden

"THE MARINE ENGINEERING CURRICULUM IN THE PHILIPPINES - AN ANALYSIS"

by

MENELIETO ALANO OLANDA
Philippines

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The contents of this paper reflect my personal views and are not necessarily endorsed by the UNIVERSITY.

Signature:
Date: 06 October, 1989

Supervised and assessed by:

PROFESSOR CHARLES E. MATHIEU
World Maritime University

Co-assessed by:

ENGINEER GORDON HODGE
Inter-Regional Sectoral Support
International Maritime Organization

F O R E W O R D

First of all I want to thank the God Almighty for giving me guidance in writing this paper. Second, to my mother who gave me inspiration in acquiring further knowledge. So with my sisters, brother, niece and nephews, and friends for their support. With my special thanks to Mr. Burton Russell, Prof. Charles Mathieu, and Engineer Gordon Hodge, without them this paper could not be completed.

ELIET

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A B S T R A C T

The Philippines, being one of the major suppliers of manpower in the maritime field, is trying her best to give proper training to the existing human resources who have elected to pursue a career as seafarers. The concept of training is directly affected by the needs of the international maritime community which are expressed in the different international conventions produced by international organizations. The most significant of these conventions are from the International Maritime Organization (IMO).

It is for this reason that this study has pinpointed the needs of the international maritime community contained in three conventions of the IMO and the Document for Guidance which was jointly formulated by the International Labour Organization and IMO. These requirements were compared to the existing marine engineering curricula in the Philippines.

The comparison shows that the Marine Engineering curricula in the Philippines differs from the needs of the international maritime community to various levels of significance. Based on these differences, the following conclusions, recommendations, and amendments have been formulated: a) Minor amendments have been recommended to the Philippine Merchant Marine Academy's curriculum; b) Major amendments have been made to the Philippine Association of Maritime Institution's BSMT-ME curriculum; c) The PAMI Associate degree in Marine Eng'g. has been recommended to be designed to be the qualification needed for a general purpose crew.

Chapter 1

THE PROBLEM

Education is growth (Dewey), in which it is characterized as education in terms of experience. Children should become tolerant and rational adult, able to cope with a relatively high degree of social freedom without abusing that freedom to interfere with the freedom or well-being of others. The school should order the child's development through experiences. This will lead to further experiences that will prepare him for the real world. These were some of the thoughts of John Dewey, one of the well known philosopher in education.

Education is so important that most people base their level of education to their job for the future. As stated in the study conducted by the Centre for Educational Research and Innovation (1983), "Most young people want to learn: they value education and believe that it will better their lives. In many cases of what schools do are pitched pretty high." This concept is true not only of developed countries where the study was conducted, but also in developing countries like the Philippines.

In the Philippines, education is a high priority not only of the people but also of the government. Educational budget has the highest allocation since 1987. Parents have to strive just to send their children to school, putting a very high investment on their children's education, hoping that they will land a good job after graduation. As mentioned in Philippine Panorama Editorial (January 15, 1989), "Parents send their children to school primarily to escape poverty in their lives, to give their children a new start, a higher status than theirs which is the everlasting struggle to survive. " But with the rapid

change in the application of new technologies in the different industries, the Philippine educational system could hardly cope with these changes. This is mostly seen in the engineering field. Change would necessitate the restructuring of the curriculum, the educational facilities, and acquiring its teaching staff. A systematic and logical approach should be taken to solve the problem due to the different factors that affect the restructuring. Restructuring the curriculum is the most logical first step in solving the problem, for it serve as the basis for the right kind of facilities needed and the right qualification and training of the schools teaching staff.

It is also mentioned in the Centre for Educational Research and Innovation (1983) report that, "Schools are supposed to prepare one's future occupational role, but they operate in isolation in actual field of work. To a great extent the curriculum ignores this situation, but there have been efforts, in the past and currently to reorient at least part of it to meet the vocational requirements as distinct from the academic requirements." The Marine Engineering course in the Philippines is in the same boat, wherein it should meet the vocational and academic requirements of the maritime industry and thereby meet the societal needs. It is for this reason that the author of this paper has chosen this study.

Background of the Study

The Republic of the Philippines with its more than 7000 islands is primarily a maritime country. Trade was conducted by sea even before the islands were conquered by Spain in 1521. But it was only in 1820, during the industrial revolution in Europe, when the first maritime school was established, the "Escuela Nautica de Manila"

now the Philippine Merchant Marine Academy (PMMA). But it was only during the American regime when the Marine Engineering course was first offered in the Philippines at Philippine School of Arts and Trade, now the Technological University of the Philippines. After the Second World War, this was followed by the private maritime schools where both Nautical Studies and Marine Engineering were offered as a two year course.

In 1963, the Philippine Nautical School (formerly Escuela Nautica de Manila) was upgraded and renamed Philippine Merchant Marine Academy, offering a Bachelors degree in Maritime Transportation majoring in either Nautical Studies or Marine Engineering. This was followed by the private maritime schools in the mid-70's offering the same degree but only the Nautical Studies as a major. The Marine Engineering course remains the same.

In the early 70's up to the early 80's the demand for Filipino seafarers increased tremendously and resulted in mass production of maritime graduates in the pivate maritime schools using their two-year curriculum in Marine Engineering and the bachelors degree in Nautical Studies.

In 1983 the Philippine Merchant Marine Academy's curriculum was upgraded, with the assistance of International Maritime Organization and the United Nations Development Programme, to conform with the 1978 STCW Convention and the present needs of the world maritime fleet. This was followed by the private maritime schools implementing most of the changes in Nautical Studies leaving behind the Marine Engineering course.

In November 10, 1987, a Department of Education Culture and Sports Order No. 111 was issued that required the upgrading of Maritime Education curriculum and set a standard and guidelines for all maritime institutions/schools. This was complied with by the

Philippine Association of Maritime Institutions, which claimed about 65 maritime schools, and took effect beginning school year 1988-89.

The ideal aim of the school is to give graduates a well-rounded education. The new Marine Engineering curriculum designed and adopted by the Philippine Association of Maritime Institutions member school should be able to meet this aim. But it is quite disturbing to note that today, only half of the thousands of graduates of the pre-sent educational system find employment (Philippine Panorama, 1989). As mentioned in the same article, "Even if we produce the kind of graduates needed by the country under our present circumstances, many of them are still unemployable ... they can't pass examinations given by the private firms or the government." It is further cited that one of the cause of the tragedies in 1987-88 (M/V Dona Paz, etc.) was traced to the hordes of unqualified or incompetent marine officers licensed by the government through rigged board examinations.

Today there are about 65000 Filipino seafarers employed by foreign shipping companies all over the world. These seafarers are sailing in international waters where most of the international maritime regulations are recognized and put into force. Most of these regulations were formulated by the International Maritime Organization whose members are mainly from maritime nations and landlocked countries. Through their conventions IMO has come up with different standards that concerns the training of seafarers, ship design and construction, and protection and preservation of maritime resources and environment.

With the increasing demand for well-trained Filipino seafarers, the Philippines is still short of meeting the

demands even though she has over 100 000 seafarers available. These were products of maritime schools in the Philippines which could not gain employment in their chosen profession. Because of this the author of this study is concerned by the disparity of the needs of the foreign principals and the product that the maritime institution in the Philippines are producing. It is for this reason that the author of this study is convinced to look deeper into the design of the Marine Engineering curriculum in the Philippines and the needs of the international maritime community which could be identified from the various IMO conventions.

Statement of the Problem

This study will attempt to answer specifically the following questions:

- What are the present curricula being used by the Marine Engineering courses in the Philippines, and specifically those offered by:
  a. The Philippine Merchant Marine Academy?
  b. The Philippine Association of Maritime Institutions member schools?

- What are the needs of the international maritime community as based on the International Maritime Organization's conventions on:
  a. The International Convention for the Safety of Life at Sea, 1974, Protocol of 1978, with 1981 and 1983 Amendments?
  b. The International Convention for the Prevention of Pollution from Ships, 1973, Protocol 1978?
  c. The International Convention on Standards of Training, Certification and Watchkeeping for

Seafarers, 1978?

d. Document for Guidance, 1985?

- Is there a significant difference between the Marine Engineering curriculum in the Philippines and the needs of the international maritime community as based on the four documents (1978 STCW Convention, MARPOL 1973/78 Convention, 1974/78 SOLAS Convention, and the 1985 Document for Guidance)?

The Hypothesis

The hypothesis is to provide a temporary answer to the problem to see if the study is valid or not. The hypothesis of this study is stated as follows:

1. There is no significant difference between the existing Marine Engineering curriculum in the Philippines and the needs of the international maritime community as identified from the four documents (1978 STCW Convention, MARPOL 1973/78 Convention, 1974/78 SOLAS Convention, and the 1985 Document for Guidance).

2. There is a significant difference between the existing Marine Engineering curriculum in the Philippines and the needs of the international maritime community as identified from the four documents (1978 STCW Convention, MARPOL 1973/78 Convention, 1974/78 SOLAS Convention, and the Document for Guidance).

Significance of the Study

This study is intended not to criticize the framers of the Marine Engineering curriculum in the Philippines but rather to help further up-grading of the said curriculum towards the achievement of a well-rounded education.

Scope and Limitation

In this study the Bachelor of Science in Marine Transportaion degree major in Marine Engineering, of the Philippine Merchant Marine Academy and the Philippine Association of Maritime Instituion will be used. The Associate degree in Marine Engineering offered by the PAMI member schools will also be used. The needs of the international maritime community will be based only on the four documents (1978 STCW Convention, MARPOL 1973/78 Convention, 1974/78 SOLAS Convention, and the Document for Guidance, 1985).

Chapter 2

THE NEEDS

A curriculum is constructed according to societal needs. The Marine Engineering curriculum in the Philippines, just like other curricula, is designed for the maritime community needs. But to what extent can this curriculum meet the international maritime needs? To talk of the needs necessarily implies some specific objectives. "Safe shipping and clean oceans", these are the objectives of the International Maritime Organization (IMO). To meet these objectives, IMO has formulated a number of conventions, many have been adopted and a good number were put into force. From these conventions the international maritime needs could be identified and will be used to analyze the marine engineering in the Philippines.

The International Maritime Organization (IMO)

The International Maritime Organization, whose convention came into effect in 1958, is a separate, autonomous organization related to the United Nations by special agreement. IMO endevours to promote safety and pollution prevention through its international conventions, the means being:

* Proper construction of ships
* Correct operational principles
* Use of proper equipment
* Promotion of enhanced training through
  - Appropriate buildings
  - Proper equipment
  - Suitably trained staff
  - Provision of model courses

All of this will have a beneficial effect particularly for developing countries and help them to be come more self

sufficient and better able to compete with developed countries.

The concept of IMO started in 1946 at the request of the United Nations Economics and Social Council (ECOSOC) to the possible establishment of a new organization solely concerned with technical matters on shipping. Under the auspices of ECOSOC a conference was held in Geneva in 1948 which adopted a convention establishing the Inter-Governmental Maritime Consultative Organization (IMCO), now the IMO. This Organization came into being in 1958.

At present, August 1989, IMO is a forum of 132 member Nations and one Associate member. This enables the member governments to meet regularly and communicate with each other quickly and easily. To ensure that other inter-governmental organizations with interest in shipping are able to make their views known, they are able to apply for a consultative status in IMO.

A number of conventions were formulated and adopted, from these conventions three conventions will be referred to, plus the Document for Guidance, 1985, which was prepared jointly by the International Labour Organization and IMO. The three conventions are:

- International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), Protocol 1978, with 1981 and 1983 Amendments

- International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73), Protocol 1978

- International Convention of Standards of Training, Certification and Watchkeeping, 1978 (STCW 78)

The International Convention for the Safety of Life at Sea, 1974, Protocol 1978, 1981 and 1983 Amendments

The SOLAS of 1974 was adopted by the International Conference on Safety of Life at Sea on November 1, 1974 and its Protocol of 1978 by the International Conference on Tanker Safety and Pollution Prevention on February 17, 1978. These were entered into force on May 25, 1980 and May 1, 1981 respectively. The Amendments to SOLAS 74/78 was adopted by the Maritime Safety Committee of IMO on November 20, 1981 and entered into force on September 1, 1984. On June 17, 1983 the Maritime Safety Committee adopted further Amendments to SOLAS 74/78 which entered into force July 1, 1986. On the same date, June 17, 1983, the Maritime Safety Committee adopted the International Code for the Construction and Equipment of Ships Carrying Liquified Gases in Bulk, making this Code mandatory under the convention.

The International Convention for the Prevention of Pollution from Ships, 1973, Protocol 1978

By IMO Resolution A.176(VI) of October 21, 1969, the IMO Assembly decided to convene in 1973 an International Conference on Marine Pollution. This Conference was held in London from October 8 to November 2, 1973.

In MARPOL 1973 Convention, Annex 1 has replaced OILPOL 1954 as the chief weapon against pollution from ships. It contains measures to prevent accidental pollution from tanker and other ships, and also deals with noxious liquid chemicals in bulk and in package form, sewage, and garbage.

The MARPOL 1973 Convention as modified by the Protocol of 1978 was entered into force in 1983.

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

Pursuant to Resolution A.248(VII) of October 15, 1971 adopted by the IMO Assembly, the Organization convene an International Conference on the Training and Certification of Seafarers which was held in London from June 14 to July 7, 1978. The Conference was convened in association with the International Labour Organization.

The following documentation formed the basis for the work of the Conference:

- a draft International Convention on Training and Certification of Seafarers and related Resolutions prepared by the Sub-Committee on Standards of Training and Watchkeeping of IMO and approved by its Maritime Safety Committee;

- proposals and comments thereon submitted to the Conference by interested governments and organizations;

- Resolutions 8 and 13 adopted by the International Conference on Tanker Safety and Pollution Prevention, 1978.

The Conference adopted the International Convention om Standards of Training, Certification and Watchkeeping for Seafarers, 1978. The Convention introduced for the first time an internationally-accepted minimum standards for the training and certification of Masters, Officers and Ratings. It also established watchkeeping standards. The Convention entered into force in 1983.

The Document for Guidance

The Document for Guidance is an international maritime training guide prepared jointly by the ILO and the IMO. It is not intended to be a minimum requirement or standards which will suit all countries. Neither it is theoretical but is based on experience. It is submitted in the belief that it will be of practical assistance when national schemes and requirements for safety training are instituted, amended or developed. This was put forward jointly by the IMO/ILO Committee on Training in the form of guidance for the following reasons:

- the actual content of necessary safety training is constantly changing; and

- the special circumstances of different countries and different trades may justify some difference in methods and applications.

The provisions of the document are directed towards the training of those engaged in the Deck and Engineering departments. But it should be noted that certain sections are applicable to all seafarers and deal with such topic as fire prevention and fire fighting, personal survival and life-saving, first aid.

The Needs of International Maritime Community

From these four documents mentioned, the needs are identified through the topics or subjects that are mentioned on Chapters, Resolutions, Regulations, Amendments, and Annexes. These are:

1. Human Relationships and Social Responsibilities
   References:
   1978 STCW Convention Attachment 2, Resolution 22
   1985 Document for Guidance - Section 29

2. Ship Management
   References:
   1978 STCW Convention - Regulation II/2, appendix, paragraph 15
   1978 STCW Convention - Regulation III/2, appendix,paragraph 6
   1985 Document for Guidance - Section 28

3. Maritime Law
   References:
   1978 STCW Convention - Regulation II/2, Appendix, paragraph 14
   1978 STCW Convention - Regulation III/2, Appendix
   paragraph 5
   1985 Document for Guidance - Section 27

4. Use of Tools
   References:
   1978 STCW Convention - Attachment 2, Resolution 9, Annex, paragraph 2(c)
   1985 Document for Guidance - Section 25

5. Marine Electrotechnology, Electronics, and Electrical Equipments and Installations
   References:
   1978 STCW Convention - Regulation III/1, Paragraph 5(g) and 6(b)(ii)
   1978 STCW Convention - Regulation III/2,

Appendix,paragraphs 3(g) and 4(c)
1978 STCW Convention - Regulation III/3,
Appendix, pragraphs 3(i) and 4(c)
1985 Document for Guidance - Section 24
1974/78 SOLAS Convention - Chapter II-1 Part D,
Regulations 1 to 24

6. Automation, Instrumentation and Remote Control Systems
References:
1978 STCW Convention - Regulation III/1,
paragraphs 5(g) and 6(b)(ii)
1978 STCW Convention - Regulation III/2,
Appendix, paragraph 3(h)
1978 STCW Convention - Regulation III/3,
Appendix, paragraph 3(j)
1985 Document for Guidance - Section 23
1974/78 SOLAS Convention - Chapter II-1, Part C,
Regulation 31, paragraphs 1 to 4

7. Pumping and Piping Systems
References:
1978 STCW Convention - Regulation III/4,
paragraph 3(c)
1978 STCW Convention, Attachment 2, Resolution 9,
Annex, paragraph 2(e)
1985 Document for Guidance - Section 22

8. Boilers and Pressure Vessels
References:
1978 STCW Convention - Regulation III/4,
paragraph 3(b)
1978 STCW Convention - Regulation III/6,
paragraph 4

1985 Document for Guidance - Section 21
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 27, paragraph 2 and 4
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 32, paragraphs 1 to 6
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 33, paragraphs 1 to 3

9. Main and Auxiliary Prime Movers
- Marine Diesel Engines
- Marine Steam Propulsion Plant
- Marine Gas Turbine

References:
1978 STCW Convention - Regulation III/1, paragraph 5
1978 STCW Convention - Regulation III/2, Appendix, paragraphs 3 to 5
1978 STCW Convention - Regulation III/3, Appendix, paragraphs 3 to 5
1978 STCW Convention - Regulation III/4, paragraphs 3 to 5
1978 STCW Convention - Regulation III/6, paragraphs 3 to 5
1978 STCW Convention - Attachment 2, Resolution 9, Annex, paragraphs 2 and 3
1985 Document for Guidance - Section 20
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 26, paragraph 3
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 27, paragraphs 1 and 5
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 28, paragraphs 1 to 4
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 34, paragraphs 1 to 4

10. Prevention of Marine Pollution

References:

1973/78 MARPOL Convention - Annexes 1 to 5

1985 Document for Guidance - Section 19

1978 STCW Convention - Regulation II/1, paragraph 11 1978 STCW Convention - Regulation II/2, Appendix, paragraph 10(h)

1978 STCW Convention - Regulation II/3, Appendix, paragraph 1(a)(xv)

1978 STCW Convention - Regulation II/4, Appendix, paragraph 21

1978 STCW Convention - Regulation III/1, paragraph 8

1978 STCW Convention - Regulation III/2, Appendix paragraphs 4(h), 4(i), 4(j) and 5

1978 STCW Convention - Regulation III/3, Appendix, paragraphs 4(h) and 5

1978 STCW Convention - Regulation III/4, paragraph 3(f)

1978 STCW Convention - Regulation III/6, paragraph 3(d)

1978 STCW Convention - Regulation V/1, paragraphs 2 and 3

1978 STCW Convention - Regulation V/2

11. First Aid and Medical Care

References:

1985 Document for Guidance - Section 17

1978 STCW Convention - Regulation II/2, Appendix, paragraph 13

1978 STCW Convention - Regulation II/3, Appendix, paragraph 1(a)(xiii)

1978 STCW Convention - Regulation II/4, Appendix,

paragraph 19
1978 STCW Convention - Regulation II/6, Appendix, paragraph 2(d)(i)
1978 STCW COnvention - Regulation III/2, Appendix, paragraph 4(k)
1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(i)
1978 STCW Convention - Regulation III/4, paragraph 3(g)
1978 STCW Convention - Regulation III/6, paragraph 2(c)(i)
1978 STCW Convention - Regulation IV/1, Appendix, paragraph (d)
1978 STCW Convnetion - Regulation IV/3, Appendix, paragraph (d)
1978 STCW Convention - Regulation VI/1(e)(vi) and Appendix, paragraphs 14 and 16

12. Oil and Chemical Tankers, and Liquified Gas Carriers
References:
1985 Document for Guidance - Section 16
1978 STCW Convention - Regulation V/1
1978 STCW Convention - Regulation V/2
1978 STCW Convention - Regulation V/3
1973/78 MARPOL Convention - Annexes I to III
1974/78 SOLAS Convention - 1983 Amendments

13. Naval Architecture, Ship Construction and Stabilityincluding Damage Control
References:
1974/78 SOLAS Convention - Chapter II-1, Part A, Regulations 1 to 24
1974/78 SOLAS Convention - Chapter II-1, Part B,

Regulation 23

1985 Document for Guidance - Section 14

1978 STCW Convention - Regulation II/2, Appendix, paragraph 8

1978 STCW Convention - Regulation II/3, Appendix, paragraph 1(a)(x)

1978 STCW Convention - Regulation II/4, Appendix, paragraphs 15 and 17

1978 STCW Convention - Regulation III/2, Appendix, paragraphs 3(i) and 4(m)

1978 STCW Convention - Regulation III/3, Appendix, paragraphs 3(k) and 4(k)

14. Manoeuvering and Ship Handling

References:

1985 Document for Guidance - Section 13, Appendix 2

1978 STCW Convention - Regulation II/2, Appendix, paragraph 7

1978 STCW Convention - Regulation III/1

15. Emergency Procedures

References:

1985 Document for Guidance - Section 12, Appendix 3

1978 STCW Convention - Regulation II/2, Appendix, paragraph 12

16. Personal Survival and Life Saving

References:

1978 STCW Convention - Regulation VI/1

1978 Document for Guidance - Section 11

17. Fire Fighting Course

References:
1978 STCW Convention - Regulation III/2, Appendix
1978 STCW Convention - Regulation III/3, Appendix
1978 STCW Convention - Regulation III/4, paragraph 2(f)
1985 Document for Guidance - Section 10, Appendix 1 and 2
1974/78 SOLAS Convention - ChapterII-2, Part A, Regulations 2 to 11

18. Thermodynamics and Heat Transmission
References:
1978 STCW Convention - Regulation III/2, Appendix, paragraph 3(a)
1978 STCW Convention - Regulation III/3, Appendix, paragraph 3(b)

19. Mechanics, Hydromechanics and Pneumatics to include variable pitch propeller
References:
1978 STCW Convention - Regulation III/2, Appendix, paragraph 3(c)
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 26, paragraph 3

20. Operational Principles of Ship's Power Installation and Refrigeration
References:
1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 26, paragraph 3
1978 STCW Convention - Regulation III/2, Appendix, paragraph 4(a)

1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(a)

21. Physical and Chemical Properties of Fuels and Lubricants

References:

1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 26, paragraph 3

1978 STCW Convention - Regulation III/2, Appendix, paragraph 3(d)

1978 STCW Convention - Regulation III/3, Appendix, paragraph 3(f)

22. Technology and Properties of Materials

References:

1978 STCW Convention - Regulation III/2, Appendix, paragraph 3(e)

1978 STCW Convention - Regulation III/3, Appendix, paragraph 3(g)

23. Steering Gear Systems

References:

1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 29, paragraphs 1 to 20

1974/78 SOLAS Convention - Chapter II-1, Part C, Regulation 30, paragraphs 1 to 4

1978 STCW Convention - Regulation III/3, Appendix, paragraphs 3(e) and 4(b)

24. Operation, Testing and Maintenance of Electrical Control Equipment

References:

1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(c)

1978 STCW Convention - regulation III/2, Appendix, paragraph 4(c)

25. Detection of Machinery Malfunction, Location of Faults and action to Prevent Damage including Vibration Analysis
References:
1978 STCW Convention - Regulation III/2, Appendix, paragraph 4(e)
1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(e)

26. Organization of Safe Maintenance and Repair Procedures
References:
1978 STCW Convention - Regulation III/2, Appendix, paragraph 4(f)
1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(f)

27. Operation and Maintenance of Cargo Handling Equipment and Deck Machinery
References:
1978 STCW Convention - Regulation III/2, Appendix, paragraph 4(d)
1978 STCW Convention - Regulation III/3, Appendix, paragraph 4(d)

28. Safe Working Practices
References:
1974/78 SOLAS Convention - Chapter II-1, Part D, Regulation 45
1978 STCW Convention - Regulation III/2,

Appendix, paragraph 4(n)
1978 STCW Convention - Regulation III/3,
Appendix, paragraph 4(l)

29. Generating Plants
Reference:
1978 STCW Convention - Regulation III/4,
paragraph 3(d)

30. Watchkeeping Routines
References:
1978 STCW Convention - Regulation III/1
1978 STCW Convention - Regulation III/4
paragraph 3(a)

31. Adequate Period of Sea-going Service
Reference:
1978 STCW Convention - Regulation III/4

32. Additional Requirements for Periodically Unmanned Machinery Spaces
Reference:
1974/78 SOLAS Convnetion - Chapter II-1, Part E, Regulations 46 to 51

* Control of propulsion machinery from navigating bridge
  Reference:
  1974/78 SOLAS Convention - Chapter II-1, Part E, Regulation 49
* Communication
  Reference:
  1974/78 SOLAS Convention - Chapter II-1, Part E, Regulation 50
* Alarm Systems

Reference:
1974/78 SOLAS Convention -Chapter II-1, Part E. Regulation 51

* Safety Systems for Machinery or Boiler Operations
Reference:
1974/78 SOLAS Convention - Chapter II-1, Part E, Regulation 52

With the needs of the international maritime community identified, this will be looked into and compared with the existing Marine Engineering curriculum in the Philippines which will be discussed in the next Chapter.

Chapter 3
THE CURRICULUM

Robin Barrow and Ronald Woods (1982) refer to the curriculum as the program or content that we intend to put to students. It is a key to educational terms, in ways that reflect or reinforce one's point of view. In their book (An Introduction to Philiosophy of Education, 1982) they have quoted J. Schwabb (1979) describing the curriculum, "...this can be used to refer to an alleged special facility to bridge the presumed gap between theory and practice." In fact, Derek Rowntree (1981) describes it as, "...one that shows signs of having been developed rather than simply having happened or been roughed out of short notice on the back of an envelope one lunch time in the bar." This simply means that all curriculum is a product of a careful study that recognized the view of the society or community to meet a particular need or needs of industry, the students, and a particular sector of society or the community.

It is on these concepts that the Marine Engineering curriculum in the Philippines was constructed. But how far could it meet the needs of the international maritime community? In restructuring, the curriculum was altered to meet the international requirements regarding the standard of training, certification and watchkeeping (1978 STCW Convention). But it is not only the international regulations that could pinpoint the needs of the world maritime industry. A look at the existing curriculum (Marine Engineering) is needed to see if it meets the needs of the world maritime industry. In particular a close look will be taken at the Philippine Merchant Marine Academy's curriculum and the curriculum adopted by the Philippine Association of Maritime Institution which is

recognized by the Department of Education Culture and Sports (Philippines).

The Marine Engineering Curriculum at the Philippine Merchant Marine Academy (PMMA BSMT-ME)

The Marine Engineering curriculum at the PMMA is one of the major courses. It leads to a degree of Bachelor of Science in Marine Transportation, a four-year course. It is the result of a three-year development program supervised by IMO thru the United Nations Development Programme (UNDP). The curriculum design was based on:

- 1978 STCW Convention
- The DECS standard curriculum and its requirement for a Bachelor of Science Degree

The revised curriculum adheres to the existing frame of the PMMA and there was no revision regarding the:

- Entrance conditions
- School year of two semesters with 20 weeks per semester, a week of 5 days, a day of 7 lessons, and a lesson of 50 minutes. This provides an average of 700 hours per semester and a total of 4 160 hours throughout the three years of Academic studies.
- Professional subjects formulated in the first 2 years of studies contain and surpass the requirements of regulation III/4 of the STCW Convention (mandatory minimum requirements for certification of engine officers-in-charge of a

watch). The studies of the last year are to upgrade the students to senior officers level of regulation III/2 of STCW Convention

- curriculum of 4-years with the third year at sea under the auspices of the PMMA.

Admission to the PMMA, is based on the following requirements:

- He must be a Filipino citizen

- Must be at least 5 feet 4 inches tall and weigh not less than 110 pounds

- Must belong to the upper 50% of the graduating class in high school

- Must have a General Point Average of 70% and above in the National College Entrance Examination (NCEE), with the following:
  * Mathematical Ability - 60% and above
  * Reading Comprehension - 60% and above

- Must pass the entrance examination given by PMMA

- Must pass the medical and physical examination as required by PMMA

- Must pass the Neuro-Psychological examination as required by PMMA

- Must pass the one month Orientation Period.

It must also be noted that the Academics is only 75% of the overall evaluation of the Midshipman (student). The remaining 25% is based on the leadership and training which is handled by PMMA's Department of Midshipmen. This comprises a semi-military training that the midshipmen have to undergo during their length of stay at PMMA.

During the one year of shipboard training the midshipmen are given a sea project that they have to accomplish through the guidance of the Chief Engineer and other Engine Officers on board the ship. It is then evaluated by PMMA's Department of Shipboard Training.

Upon graduation the students are awarded a Bachelor of Science in Marine Transportation, major in Marine Engineering Degree, a Fourth Marine Engineers License from the Professional Regulation Commission (PRC), and a Commission in the Corps of Officers in the Armed Forces of the Philippines (Philippine Navy) Reserve Force.

The 1982 PMMA BSMT-ME Revised curriculum is as follows:

First year

First Semester	C	L	U	TH	Second Semester	C	L	U	TH
Mathematics	5	-	5	100	Mathematics	5	-	5	100
Mechanics	3	-	3	60	Mechanics	3	-	3	60
Chemistry	3	1	4	80	Thermodynamics	3	-	3	60
Drawing	3	-	3	60	Machine Shop	2	4	4	120
Machine Shop	2	4	4	120	English	3	-	3	60
Spanish	3	-	3	60	Phil. History	3	-	3	60
Phys. Training	-	2	1	40	Spanish	3	-	3	60
Naval Science	2	4	2	120	Phys. Training	-	2	1	40
Thermodynamics	3	-	3	60	Naval Science	2	4	2	120
	35		28	700		35		28	700

Second Year

Mathematics	4	-	4	80	I.C.E.	3	-	3	60
Mechanics	3	-	3	60	Steam	2	-	2	40
Thermodynamics	3	-	3	60	Safety	2	-	2	40
I.C.E.	2	-	2	40	English	3	-	3	60
Steam	2	-	2	40	Seamanship	3	-	3	60
Electricity	3	1	4	80	First Aid	1	-	1	20
English	3	-	3	60	Aux. Machinery	4	-	4	80
Spanish	3	-	3	60	Electricity	3	1	3	80
Pilipino	3	-	3	60	Spanish	3	-	3	60
Phys. Training	-	2	1	40	Pilipino	3	-	3	60
Naval Science	2	4	2	120	Naval Science	2	4	2	120
Shipbd. Trng.	-	2	2	40	Phys. Training	-	2	1	40
	37		32	720		35		29	700

Third Year

(One year Actual Shipboard Practice)

Fourth Year

Mar. Power Plt.	4	-	4	80	Mar. Power Plt.	6	-	6	120
Tribology	2	-	2	40	Naval Archit.	3	-	3	60
Metallurgy	3	1	3	80	Automation	3	1	4	80
Econ. and Mgmt.	5	-	5	100	Maritime Law	4	-	4	80
Automation	2	1	2	60	Environ.Science	2	-	2	40
Electronics	2	1	2	60	Elect. Systems	2	-	2	40
Elect. Systems	2	-	2	40	Machine Design	3	-	3	60
Machine Design	3	-	3	60	Psychology	3	-	3	60
Strengt of Mat.	3	-	3	60	Land Reform	3	-	3	60
Phil. Const.	3	-	3	60	Pop. Education	3	-	3	60
Rizal	3	-	3	60	Shipbd. Trng.	-	2	2	40
	35		32	700		35		35	700

Note:

C - Class/Lecture

L - Laboratory

TH - Total Hours (C + L)

(See Annex 1 for Professional Subject description)

This gives a total of 2 700 hours of Lecture and Laboratory for the technical subjects (Mathematics, Physical Science, and Professional and allied subjects) and about 1520 hours of Lecture on Non-Technical subjects (Languages, Humanities and Social Sciences, and other subjects).

In the curriculum described above the requirement for Spanish was decreased by six units due to student pressure, and because it is irrelevant for today's needs. This was replaced by a subject in Computers and additional hours added to English and Mathematics in 1987.

The Philippine Association of Maritime Institution (PAMI) Marine Engineering Curriculum

The PAMI adopted Marine Engineering curriculum is the result of DECS Order No. 111, Series 1987 which sets the standards of Maritime Education in the Philippines. These courses include:

- The 10 or 6-month Basic Merchant Marine Course
- The 2-year Associate in Marine Engineering
- The 4-year Bachelor of Science in Marine Transportation major in Nautical Studies or Marine Engineering

- The 4-year Bachelor of Science in Customs Administration

- The 4-year Bachelor of Science in Naval Architecture and Marine Engineering

The Order supersedes all existing policies and standards relating to Maritime Courses and took effect at the beginning of the school year 1988-89.

From these courses, only the 2-year Associate in Marine Engineering and the 4-year Bachelor of Science in Marine Transportation major in Marine Engineering will be looked into since the 4-year Bachelor of Science in Naval Architecture and Marine Engineering is geared more to a landbased job (shipyard, etc.).

The 4-year BSMT-ME is designed to produce quality engineering officers in all levels who are highly trained and responsive to the demands and technological advances in shipboard operations, shipping management, ship propulsion and engine operations, maintenance and repair, both in national and international shipping.

For the 2-year Associate in Marine Engineering (AME), the curriculum is focused on having engineering officers prepared for shipboard operations, not on the higher management level and in teaching. Having only two years of academic preparation and two years of apprenticeship confines the AME graduates to operation, maintenance and repair of the ship's machinery installations.

The entrance requirement for BSMT-ME is a passing mark in the NCEE in addition to other requirements set by the respective schools. On the other hand, the entrance requirement for the AME could be set only by the

respective school and does not need a passing mark in the NCEE. It should be noted that the common requirement of the two courses is that the applicant must be at least a high school graduate.

The minimum requirement for graduation in BSMT-ME is 168 units including the units earned during the 1-year of apprenticeship. The 2-year AME requires 102 units without earned units in apprenticeship.

The curriculum is designed as a ladderized curriculum. Students who complete the first year curriculum subjects may be granted a certificate of completion of the Basic Merchant Marine course (Marine Engineering), provided that all practical seamanship subjects have been duly accomplished.

Students who finished the 2-year AME course before 1973 need no NCEE credentials if they want to pursue a BSMT degree for upgrading purposes. After 1973, students who proceed to the 4-year BSMT degree must pass the NCEE requirement and complete only the subjects they have not taken in the 2-year AME course.

The Bachelor of Science in Marine Transportation major in Marine Engineering adopted by PAMI memeber schools is as follows:

First Year

First Semester	C	L	U	Second Semester	C	L	U
English 111	3	-	3	English 121	3	-	3
Mathematics 111	5	-	5	Mathematics 121	3	-	3
Chemistry 111	2	3	3	Physics 121	3	3	4
Eng'g. Draw. 111	-	6	2	Marine Eng'g. 121	-	6	2
Pract.Seaman. + PE	-	3	1	Marine Eng'g. 122	2	-	2
Typing 111	-	3	1	Pilipino 121	3	-	3
Aptitude for Serv.				Aptitude for Serv.			

and Value Edu. 111	-	3	1	and Value Edu. 121	-	3	1
Marine Eng'g. 111	-	6	2	Eng'g. Drawing 121	-	6	2
Pol. Science 111	3	-	3	Pract. Seaman. +PE	-	3	1
Pilipino 111	3	-	3	Naval Science 12	-	-(1.5)	
Naval Science 11	-	-(1.5)					
	16	24	24		14	21	21

Second Year

English 211	3	-	3	English 222	3	-	3
Mathematics 211	3	-	3	Mathematics 222	3	-	3
Physics 211	3	3	4	Spanish 221	3	-	3
Naval Archit. 211	2	3	3	Marine Eng'g. 221	3	6	5
Spanish 211	3	-	3	Marine Eng'g. 222	3	-	3
Psychology 211	3	-	3	Marine Eng'g. 223	2	3	3
Pract. Seaman. + PE	-	3	1	Pract. Seaman. + PE	-	3	1
Marine Eng'g. 211	2	3	3	Marine Eng'g. 224	2	-	2
Naval Science 21	-	-(1.5)		Naval Science 22	-	-(1.5)	
	19	12	23		19	12	23

Third Year

Marine Eng'g. 311	2	3	3	Marine Eng'g. 321	2	3	3
Marine Eng'g. 312	3	6	5	Marine Eng'g. 322	2	3	3
Marine Eng'g. 313	3	-	3	Marine Eng'g. 323	1	2	3
Marine Eng'g. 314	3	-	3	Ship Business 321	3	-	3
Comp. Science 311	3	-	3	Comp. Science 321	2	3	3
Eng'g. Economics +				Marine Laws 324	3	-	3
Land Reform & Tax.	3	-	3	Social Science 321	3	-	3
	17	9	20		16	11	21

Fourth Year

One year (2-semesters of Shipboard Training) 36 Units
Practical Apprenticeship on board sea-going vessel, must complete a training experience log book which will validate the training received.

Note:

(See Annex 2 for subject description)

Completion of the first three years of Academic studies may qualify the student for the title of Associate in Marine Engineering.

After graduation the students will be awarded a Degree in Bachelor of Science in Marine Transportation major in Marine Engineering. Then he/she is qualified to take a Fourth Marine Engineer's board examination given by the PRC. Only after passing such an examination is he/she certified to act in the capacity of Watch-engine-Officer on board merchant vessels.

During the 3-year academics the student takes a total of 3420 hours of lecture and laboratory. Completion of Practical Seamanship II, III and IV entitles the student to STCW "Certificate of Completion" of the Fire Fighting, First Aid, Survival Craft, and Personal Survival if such completion includes the practicum aspects of these courses.

The 2-year Associate in Marine Engineering Curriculum is as follows:

First Year

First Semester	C	L	U	Second Semester	C	L	U
English 111	3	-	3	English 121	3	-	3
Mathematics 111	5	-	5	Mathematics 121	3	-	3
Physics 111	3	-	3	Physics 121	3	6	5
Drawing 111	-	6	2	Drawing 121	-	6	2
Marine Eng'g. 111	-	6	2	Naval Archit. 121	3	-	3
Pilipino 111	3	-	3	Pilipino 121	3	-	3

Aptitude for Serv.				Aptitude for Serv.				
+ Value Edu. 111	-	3	1	+ Value Edu. 121	-	3	1
Prat. Seaman. + PE	-	3	1	Pract. Seaman. + PE	-	3	1
Naval Science 11	-	-(1.5)		Naval Science 12	-	-(1.5)	
	17	18	23		15	24	23

Second Year

English 211	3	-	3	Marine Eng'g. 221	3	6	5
Marine Eng'g. 211	3	6	5	Marine Eng'g. 223	2	-	2
Elect. Eng'g. 211	2	3	3	Marine Eng'g. 224	1	3	2
Computer 111	2	3	3	Marine Eng'g. 225	2	3	3
Tax., Land Reform				Elect. Eng'g. 221	2	3	3
+ Family Planning	3	-	3	Marine Eng'g. 215	2	3	3
Pract. Seaman. + PE	-	3	1	Computer 122	2	3	3
Naval Science 21	-	-(1.5)		Typing 111	2	3	3
				Prat. Seaman. + PE	-	3	1
				Naval Science 22	-	-(1.5)	
	19	12	21		16	21	23

Note:

(See Annex 2 for subject description)

The AME curriculum will have two years of apprenticeship (1-year on shipboard or on shipyard; and 1-year of shipboard). This is cummulative and no units are earned. This satisfies the requirements of the licensure examination for the Fourth Marine Engineers given by the PRC.

The students completing the 2 years of studies have accumulated a total of 2140 hours of lecture and laboratory.

The relevance of the Marine Engineering curricula in the Philippines to the identified needs of the international maritime community (see Chapter 2) will be looked into in the next chapter.

Chapter 4
THE ANALYSIS

Mr Coluciello, during his lecture at the World Maritime University (June 28, 1989), described analysis as the comparison of the existing data to the standards. This set of standards is based from national regulations which has taken into consideration international requirements. The comparison of standards to the existing data is made to arrive at a conclusion that will help in solving problems. In fact in this study the similarities and dissimilarities of the two variables as described in Chapter 2 and 3 will be examined in order to draw a conclusion, recommendation or amendments to the existing curriculum (Marine Engineering) in the Philippines. But before we go further let us have a look on how this Chapter is to be treated.

The Framework

As mentioned above this Chapter will deal with the comparative analysis of the existing curriculum (Marine Engineering) to the needs of the international maritime community as identified in the four documents (1978 STCW Convention, 1974/78 SOLAS Convention with its 1981 and 1983 Amendments, 1973/78 MARPOL Convention, and the 1985 Document for Guidance). This relationship between variables can be described by the paradigm below:

The Marine Engineering Curricula in the Philippines	The Needs of the International Maritime Community identified by:
- PMMA BSMT-ME	- 1978 STCW Convention
- The PAMI Curricula	- 1973/78 MARPOL Conv.
* BSMT-ME	- 1974/78 SOLAS Conv.
* AME	- 1985 Document for Guidance

The Treatment

Since this study deals with the analysis of existing documents, it is difficult to use a statistical treatment that will give an answer to the problem (see Chapter 1). The alternative was provided by the hypothesis, as stated in Chapter 1. This will serve as a basis for formulating the conclusions, recommendations and amendments to be made in the next chapter. Therefore, the description of the needs will be compared to the existing curricula in the Philippines (Marine Engineering). The significance of the study will be measured based on the following:

- The curriculum will be measured on how far it meets needs as stated in the different subjects or topics. This will be weighed as follows;
  * Needs Fully Covered
  * Needs Partially Covered
  * Needs Not Covered

- After determining how much the curriculum has

fully covered the required needs, the overall evaluation of the curriculum will be based on a percentage ratio between the identified needs and the topics covered.

percentage of needs covered = number of needs not covered / total number of needs identified

Even though the comparison will be based on the existing facts, the author of this paper will try to rationalize and be fair regarding the similarites and dissimilarities of the topics described in the curriculum and the identified needs. This study will be invalid if 10% or less of the identified needs (see Chapter 2) is not meet by the Marine Engineering curricula in the Philippines (see Chapter 3).

The Comparative Description of the Needs and the Curriculum

1. Human Relationships and Social Responsibilities

In the PAMI BSMT-ME curriculum this is met by the subjects in Psychology and Aptitude for the Service and Value Education. However, for the PAMI AME curriculum, Psychology is not offered.

In the PMMA BSMT-ME curriculum this is also met by Psychology. This is compensated by the students' performance on the semi-military phase of training, which is conducted by the Academy's Department of Midshipmen.

This particular need is met by the two BSMT-ME curricula but only partly met by the AME curriculum. However this covers only the basic understanding of human nature in national scope and does not include the

understanding of foreign cultures, values and traditions.

2. Ship Management

The PMMA BSMT-ME curriculum has tried to meet this need by offering a subject in Economics and Management. This covers largely the economics concepts but is almost negligible in managment concepts. The economics concepts are based on shipping economics.

The PAMI BSMT-ME curriculum has tried to answer this need with subjects in Ship Business, Engineering Economics and Land Reform and Taxation. The AME curriculum has only the Land Reform and Taxation subject being offered.

Both the BSMT-ME curriculum fall short in answering the needs in management even though both have offered subjects in Economics. The AME curriculum could hardly fill this particular requirement hence the subject in Land Reform and Taxation will not deal with either shipping economics or management.

3. Maritime law

The subject in Maritime Law was made to meet this particular requirement both in the PAMI and PMMA BSMT-ME curriculum. However the PAMI AME curriculum does not offer any subject to meet this need.

4. Use of tools

This is met in the PMMA BSMT-ME curriculum by the study of Machine Shop offered in two semesters of the first year. The PAMI BSMT-ME and AME curricula meet this requirement under the subject title Marine Engineering 111 and 121.

5. Marine Electrotechnology, Electronics, and Electrical Equipment and Installations

In order to properly analyze these needs we have to break this up into three subject areas.

a. Marine Electrotechnology

This particular need is not mentioned in any subject in the three curricula. But the subject in electricity is offered both in the PAMI and the PMMA BSMT-ME curriculum. The AME curriculum is offering a subject in basic electricity for two semesters. For the BSMT-ME curricula, the PAMI is alloting only one semester for the Electricity subject while the PMMA is offering a two semester for the same subject.

The PMMA BSMT-ME curriculum fully covers this area while the PAMI BSMT-ME curriculum partially covers it. The AME curriculum covers this area.

b. Electronics

Under the subject title Marine Engineering 322 the PAMI BSMT-ME curriculum replies to this particular need. However its AME curriculum is not offering electronics subject.
The PMMA BSMT-ME curriculum also replied to this requirement with a subject in electronics.

c. Electrical Equipments and Installations

The PMMA BSMT-ME curriculum offers the subject Electrical Systems for two semesters to satisfy this particular requirement. With the subject title Marine Engineering 323, the PAMI BSMT-ME curriculum meets this particular need. However the AME curriculum does not include the topic of electrical equipment and installation in the curriculum.

6. Automation and Remote Control Systems

Both the BSMT-ME curricula meet this requirement by offering subjects in Automation and Control. However, the PAMI curriculum is offering it for one semester under the subject title Marine Engineering 323 which is also designed to meet the topic on Electrical Equipments and Installations. The PMMA curriculum is offering this for two semesters with a 6 unit load. The AME curriculum does not offer any.

7. Pumping and Piping Systems

With the subject title Auxiliary Machinery, the PMMA BSMT-ME curriculum was able to meet this need. However, both the BSMT-ME and AME curricula of PAMI does not mention this particular area.

8. Boilers and Pressure Vessels

The subject of Marine Boilers is taken under the subject title Steam Engineering in the First Semester of the Second Year of the PMMA curriculum. This is again being covered in the Marine Power Plant I subject given during the First Semester of the Fourth Year. The PAMI BSMT-ME curriculum is offering this under subject title Marine Engineering 212. With AME curriculum this is being taken under subject title Marine Engineering 221. However both curricula are alloting only one semester for this area.

9. Main and Auxiliary Prime Movers (Marine Diesel Engines, Marine Steam Propulsion Plant, Marine Gas Turbine)

These particular requirements are met by the three curricula in different subject titles.

a. Marine Diesel Engines

This is met in the PMMA BSMT-ME curriculum by offering a subject in Internal Combustion Engine (ICE) for two semesters with deeper discussion under the subject title Marine Power Plant I. The PAMI BSMT-ME curriculum meets this under the subject title Marine Engineering 221. With the AME curriculum this is met under the subject title Marine Engineering 211.

However both the PAMI curricula offer this topic for only one semester. This partly covers this requirement under the PAMI curricula. The PMMA BSMT-ME curriculum fully covers this requirement.

b. Marine Steam Propulsion Plant

Under the PMMA BSMT-ME curriculum this is taken under the following subject areas:

* Steam Engineering I for the Marine Boiler
* Steam Engineering II for the Steam Turbine
* Marine Power Plant I for deeper discussion on the Steam Propulsion Plant

Under the PAMI BSMT-ME curriculum this is discussed under the subject title Marine Engineering 312. With the AME curiculum this is met under the subject title Marine Engineering 221. The PMMA BSMT-ME curiculum fully covers this area. However both the PAMI curricula only partially cover this requirement due to the time allotment and subject content.

c. Marine Gas Turbine

All the three curricula do not mention this particular area.

10. Prevention of Marine Poluution

Both the PMMA and PAMI BSMT-ME curricula satisfy this requirement, with the PMMA offering a subject in Evironmental Science and the inclusion of this subject under the subject title Practical Seamanship and Physical Education 221 in the PAMI curriculum. Under the AME curriculum this requirement is being offered under the latter.

11. First Aid and Medical Care

The PMMA BSMT-ME satisfies this requirement under the subject First Aid and Ship Medicine. For the PAMI BSMT-ME and AME curricula they have incorporated this requirement under the subject title Practical Seamanship and Physical Education 121. Topics in Medical Care are not offered.

12. Oil and Chemical Tankers, and Liquified Carriers

In the PAMI BSMT-ME and AME curricula this particular topic is partly discussed under subject title Practical Seamanship and Physical Education 221. However this is not mentioned in the PMMA BSMT-ME curriculum.

13. Naval Architecture, Ship Construction and Stability including Damage Control

The PMMA BSMT-ME curriculum satisfies this requirement by offering two related subjects;

* Seamanship which deals with Ship Construction
* Naval Architecture deals primarily with design calculations and stability

With the PAMI BSMT-ME curriculum they offer Naval

Architecture 221 which deals with the basics of Naval Architecture to include ship nomenclature. The AME curriculum offers this under Naval Architecture 121 but deals only with ship nomenclature. The topic on Damage Control is not mentioned in the three curricula.

14. Manoeuvering and Ship Handling

This topic is not offered in the three curricula.

15. Emergency Procedures

Under the PMMA BSMT-ME curriculum this requirement is touched on under the subject title Ship Safety. Emergency Procedures is lightly taken under Marine Power Plant subject. The PAMI curriculum does not mention this particular topic but it might be hidden in such topics as Internal Combustion Engines, Steam Propulsion Plant and other closely related topics.

16. Personal Survival and Life Saving

This is met by the three curricula with the subject title Ship Safety under the PMMA curriculum and Practical Seamanship and Physical Education 121 under the PAMI BSMT-ME and AME curricula.

17. Fire Fighting Course

This need is included under subject title Ship Safety of the PMMA BSMT-ME curriculum and Practical Seamanship 211 for the PMMA BSMT-ME and AME curricula.

18. Thermodynamics and Heat Transmission

These topics are given a lot of emphasis under

the PMMA BSMT-ME curriculum. A total of 9 Units are distributed in three semesters in Thermodynamics with its application emphasyzed in;

* Internal Combustion Engine,
* Steam Engineering,
* Auxiliary Machinery, and
* Marine Power Plant I and II.

For the PAMI BSMT-ME curriculum they are offering a 2 unit course in Thermodynamics in addition to the basic principles gained in Physics. Practical applications are also discussed in subject titles Marine Engineering 221 and 312. This is not covered in the AME curriculum.

19. Mechanics, Hydromechanics and Pneumatics to include Variable Pitch Propeller

The subject in Mechanics is offered in the PMMA BSMT-ME curriculum with a 9 Units total distributed for three semesters. The last semester focuses on fluid mechanics. Its application is further discussed in Automation subject. The PAMI BSMT-ME curriculum offers a subject title Marine Engineering 313 with a 3 unit load to partially cover this need. This is not mentioned in the AME curriculum. However basic principles are discussed under subject title Physics 121.

20. Operational Principles of Ship's Power Installation and Refrigeration

The first requirement is covered by Electrical Systems subjects under the PMMA BSMT-ME curriculum. The PAMI BSMT-ME curriculum covers this area with the Marine Engineering 323 subject. This is not covered under the AME curriculum.

On the second requirement the Auxiliary Machinery and Marine Power Plant subjects cover this under the PMMA BSMT-ME curriculum. A topic in Refrigeration under subject title Marine Engineering 211 covers this area under the PAMI BSMT-ME curriculum. This is also offered under the AME curriculum under the subject title Marine Engineering 215.

21. Physical and Chemical Properties of Fuels and Lubricants

The PMMA BSMT-ME curriculum satisfies this requirement with the subject in Tribology. With the PAMI BSMT-ME curriculum, they offer it under subject title Marine Engineering 222. The AME curriculum does not offer any.

22. Technology and Properties of Materials

Under three subjects the PMMA BSMT-ME curriculum meets this requirement. They are;

* Strength of Materials
* Metallurgy
* Machine Design

The PAMI BSMT-ME curriculum offered the subjects;

* Marine Engineering 122 - Engineering Materials
* Marine Engineering 313 - Technical Mechanics
  Strength of Materials

Its AME curriculum partially meets this requirement under subject title Marine Engineering 225.

23. Operation, Testing and Maintenace of Electrical Control Equipment

These requirements are partly discussed under the following subjects;

* Electrical Systems,
* Electricity, and
* Automation under the PMMA BSMT-ME curriculum.

On the other hand the PAMI BSMT-ME curriculum partly discusses this requirement in the subject titles;

* Marine Engineering 323, and
* Marine Engineering 223.

The AME curriculum partly complied with this requirement under subject titles;

* Marine Engineering 211, and
* Marine Engineering 221.

24. Detection of Machinery Malfunction, Location of Faults and action to Prevent Damage to include Vibration Analysis

This is met by the subject Marine Power Plant I under the PMMA BSMT-ME curriculum. This is still incorporated under subjects;

* Internal Combustion Engine, and
* Steam Engineering.

This is not mentioned under the PAMI BSMT-ME and AME curricula.

25. Organization of Safe Maintenance and Repair Procedures

This need is meet by the PMMA BSMT-ME under Marine Power Plant I subject under the topic Planned Maintenance. Again there is no mention of this particular need under the PAMI BSMT-ME and AME curriculum.

26. Operation and Maintenance of Cargo Handling Equipment and Deck Machinery

This is partially covered by the PMMA BSMT-ME curriculum under subject title Auxiliary Machinery.

The PAMI BSMT-ME has included the topic Cargo Boom Rigging under the subject title Practical Seamanship and Physical Education 221. Other than this no other related topic is mentioned.

27. Safe Working Practices

This is partly discussed under subject titles;

* Ship's Safety,
* Machine Shop, and
* Internal Combustion Engine under the PMMA BSMT-ME.

For the PAMI BSMT-ME nd AME curricula a topic in Safety Procedures is included under subject title Practical Seamanship and Physical Education 221 to meet this requirement.

28. Generating Plants

The PMMA BSMT-ME curriculum meets this requirement under the subject Electrical Systems. Under the subject title Marine Engineering 323 the topic on Electrical Distribution on Engineering Machineries meets this requirement under the PAMI BSMT-ME curriculum.

29. Watchkeeping Routines

This is met by the PAMI BSMT-ME and AME curricula under the subject title Aptitude for the Service 111 and 121. Under the PMMA BSMT-ME curriculum there is no mention of this area but their training under the Department of Midshipmen more than compensates for this requirement.

30. Adequate Period of Sea-going Service

Both the PAMI and PMMA BSMT-ME curricula meet this requirement. But the PMMA curricula offers an additional subject in Shipboard Training which is

usually a visit to the ships in the Port of Manila for practical discussion. Even though 2 years of apprenticeship is required under the PAMI AME curriculum, this is not a requirement for graduation. Instead this is to qualify graduates to take the board examination for Fourth Marine Engineers.

31. Additional Requirements for Periodically Unmanned Machinery Spaces
    * Control of Machinery Spaces from Navigating Bridge
    * Communication
    * Alarm Systems

    This particular requirement is not incorporated in the three curricula. However the basic principles of Automation are closely related to the first topic. The second topic is related to English and the third to Ship's Safety.

32. Safety Systems for Machinery or Boiler Operations

This particular requirement is taken up during the discussion in Internal Combustion Engines and Steam Propulsion Plant under the PMMA BSMT-ME curriculum. Under the PAMI BSMT-ME curriculum this topic is discussed under subject titles Marine Engineering 221 and 312.

The Summary

After looking at the needs and comparing them with the subjects and topics within the existing Marine Engineering curricula in the Philippines, a recapitulation of the similarities and dissimilarities of the two variables is needed. To do this the following descriptions are used:

- Needs Fully Covered
- Needs Partially Covered

- Needs Not Covered

For the PMMA BSMT-ME curriculum the result of the comparative analysis is as follows.

Needs Fully Covered

- Maritime Laws
- Use of Tools
- Marine Electrotechnology, Electronics, and Electrical Equipment and Installations
- Automation, Instrumentation and Remote Control Systems
- Pumping and Piping Systems
- Boilers and Pressure Vessels
- Main and Auxiliary Prime Movers (Marine Diesel Engines, and Marine Steam Propulsion Plant)
- Prevention of Marine Pollution
- First Aid and Medical Care
- Naval Architecture, Ship Construction and Stability including Damage Control
- Personal Survival and Life-Saving
- Fire Fighting Course
- Thermodynamics and Heat Transmission
- Mechanics, Hydromechanics and Pneumatics to include Variable Pitch Propeller
- Operational Principles of Ship's Power Installation and Refrigeration
- Physical and Chemical Properties of Fuels and Lubricants
- Technology and Properties of Materials
- Steering Gear Systems
- Detection of Machinery Malfunction, Location of Faults and Action to Prevent Damage to include

Vibration Analysis
- Operation and Maintence of Cargo Handling Equipment and Deck Machinery
- Organization of Safe Maintenance and Repair Procedures
- Safe Working Practices
- Generating Plants
- Watchkeeping Routines
- Adequate Period of Sea-going Service

Needs Partially Covered
- Safety Systems for Machinery or Boiler Operations
- Emergency Procedures
- Human Relationships and Social Resposibilities
- Ship Management

Needs Not Covered
- Main and Auxiliary Prime Movers (Marine Gas Turbine)
- Oil and Chemical Tankers, and Liquified Gas Carriers
- Additional Requirement for Periodically Unmanned Machinery Spaces
- Manoeuvering and Ship Hndling

For the PAMI BSMT-ME curriculum the result of the comparative analysis is as follows:

Needs Fully Covered
- Human Relationships and Social Responsibilities
- Maritime Law
- Use of Tools
- Marine Electrotechnology, Electronics, and

Electrical Equipment and Installations

- Automation, Instrumentation and Remote Control Systems
- Boilers and Pressure Vessels
- Main and Auxiliary Prime Movers (Marine Diesel Engine and Marine Steam Propulsion Plant)
- Prevention of Marine Pollution
- Naval Architecture, Ship Construction and Stability including Damage Control
- Personal Survival and Life Saving
- Fire Fighting Course
- Operational Principles of Ship's Power Installations and Refrigeration
- Physical and Chemical Properties of Fuels and Lubricants
- Generating Plants
- Watchkeeping Routines
- Adequate Period of Sea-going Service

Needs Partially Covered

- Ship Management
- First Aid
- Oil and Chemical Tankers, and Liquified Gas Carriers
- Thermodynamics and Heat Transmission
- Mechanics, Hydromechanics and Pneumatics to include
  Variable Pitch Propeller
- Technology and Properties of Materials
- Operation, Testing and Maintenance of Electrical Control Equipment
- Operation and Maintenance of Cargo Handling Equipment and Deck Machinery
- Safe Working Practices

- Safety Systems for Machinery or Boiler Operations

Needs Not Covered

- Pumping and Piping Systems
- Main and Auxiliary Prime Movers (Marine Gas Turbine)
- Medical Care
- Emergency Procedures
- Manoeuvering and Ship Handling
- Steering Gear Systems
- Detection of Machinery Malfunction, Location of Faults and Action to Prevent Damage to include Vibration Analysis
- Organization of Safe Maintenace and Rrepair Procedures
- Additional Requirement for Periodically Unmanned Machinery Spaces

With the PAMI AME curriculum the result of the comparative analysis is as follows:

Needs Fully Covered

- Boilers and Pressure Vessels
- Main and Auxiliary Prime Movers (Marine Diesel Engines and Marine Propulsion System)
- Prevention of Marine Pollution
- Naval Architecture, Ship Construction
- Personal Survival and Life Saving
- Fire Fighting Course
- Refrigeration
- Watchkeeping Routines
- Use of Tools

Needs Partially Covered

- Human Relationships and Social Responsibilities
- Marine Electrotechnology
- First Aid
- Oil and Chemical Tankers, and Liquified Gas Carriers
- Thermodynamics and Heat Transmission
- Mechanics, Hydromechanics and Pneumatics to include Variable Pitch Propeller
- Technology and Properties of Materials
- Operation, Testing and Maintenance of Electrical Control Equipments
- Operation and Maintenance of Cargo Handling Equipment and Deck Machinery
- Safe Working Practices
- Generating Plants

Needs Not Covered

- Safety Systems for Machinery or Boiler Operation
- Additional Requirements for Periodically Unmanned Machinery Spaces
- Adequate Period of Sea-going Service
- Organization of Safe Maintence and Repair Procedures
- Detection of Machinery Malfunction, Location of Faults and Action to Prevent Damage to include Vibration Analysis.
- Steering Gear Systems
- Physical and Chemical Properties of Fuels and Lubricants
- Operational Principles of Ship's Power Installations
- Emergency Procedures
- Manoeuvering and Ship Handling

- Medical Care
- Main and Auxiliary Prime Movers
- Pumping and Piping Systems
- Automation, Instrumentation and Remote Control Systems
- Electronics and Electrical Equipments and Installations
- Maritime Law
- Ship Management

As the result of the comparative analysis we arrive at the following figures:

CURRICULUM	Percentage of Needs Covered		
	Fully	Partially	Not
PMMA BSMT-ME	75%	12.5%	12.5%
PAMI BSMT-ME	50%	25%	25%
PAMI AME	28%	34%	38%

In the next Chapter, the conclusions, recommendations and amendments will be covered, based on the previous stated data.

Chapter 5

CONCLUSIONS, RECOMMENDATIONS, AND AMENDMENTS

This Chapter has three main parts; the Conclusions, Recommendations, and Amendments. Conclusions because after we have finished our comparative analysis we have to arrive at a decision that will be used as a basis for formulating the recommendations. This is to suggest desirable solutions to the existing problems, solutions that will help improve the existing standards and quality of graduates in the Marine Engineering field in the Philippines. Amendments to the existing curriculum will be formulated as a suggestion to meet the goals to be identified in the conclusions and recommendations. This will actually consist of the ideal curriculum that will meet the needs of the international maritime community.

The Conclusions

After we read the first four Chapters we find that the research problems raised in Chapter 1 are already answered. Upon finding the answer to the research problems we come up to the following conclusions:

For the PMMA BSMT-ME Curriculum

- With the 12.5 % of the needs not covered in the curriculum we could conclude that there is still a significant difference between the two variables. The topics that were not covered are;

  * Main and Auxiliary Prime Movers

    Marine gas turbine is not primarily used in the marine field and threfore not considered during the reconstruction of the curriculum. However this was considered in the 1978 STCW

Convention and the 1974/78 SOLAS Convention. This suggests that knowledge of basic principles in this area is important for the possible application of this equipment in the marine field in the near future. Not addressing this will be a handicap to marine engineering graduates in the Philippines in the future.

* Oil and Chemical Tankers, and Liquified Gas Carriers

This topic is a large handicap to the curriculum, considering that the four documents referred to in this study all mentioned this topic. Knowledge of the construction, operation and safety requirement for the different type of ships is essential for the person who will be operating these ships.

* Additional Requirements for Periodically Unmanned Machinery Spaces

With the advance technology applied on board today's ships, shipping companies and operators are looking for well-qualified seafarers. This topic is very important since the newly built ship are fully automated and have a reduced crew requirement. The ship of the future envisions of further reducing the number of crew on board the ship. This will mean that not considering this topic in formulating a curriculum will have a drastic effect on the manpower development of a country. Even though this is closely related to the subject in Automation and Control, its application is not limited to the Engine

Officers nor to the Deck Officers. It applies to both. Therefore non inclusion of this topic will be a handicap for the future graduates of the Marine Engineering.

* Manoeuvering and Ship Handling

Even though this topic is more for a Deck Officer, a basic knowledge in this area will help a lot in understanding the relationship between the job of other personnel on board and how our particular job is related to it. Non inclusion of manoeuvering and ship handling subject in the curriculum will serve as a handicap for the effective and efficient ship operation.

- Aside from the 12.5% of the needs not covered , still there are about 12.5% that are only partially covered due to the following;
  * In a particular subject title (e.g. Auxiliary Machinery, etc.) several topics are entirely different from each other.
  * The time allotment for such subject is so limited that it is quite hard for the instructor/professor handling that particular subject to fully discuss all the topics.
  * The inadequeacy of instructional equipment and materials added to the problem in speeding up the instruction. This is true not only about the areas that are partially covered but also to the fully covered areas.

Overall, the PMMA BSMT-ME curriculum satisfies the requirements mentioned in the four documents with a little degree of deviation from it. We could therefore conclude

that this curriculum satisfies the todays requirement but will fall short of meeting the needs in the future.

For the PAMI BSMT-ME Curriculum

- With 25% of the identified needs not covered, this curriculum seems to fall short of today's requirements. However a look at the topics that were not covered by this curriculum is appropriate before giving our conclusion. These are:

  * Pumping and Piping Systems

    This is part of the ship power plant that is essential for the operation of the ship. This is where the supply to feed the engine of the necessary ingredients for its operation is coming from. Its design and operation is very necessary to know for the personnel manning and operating the ship. non inclusion of pumping and piping systems topic in the curriculum will be a very big handicap in the present curriculum structure.

  * Main and Auxiliary Prime Movers (Gas Turbine) (See comment on the PMMA BSMT-ME)

  * Medical Care

    This subject is closely related to First Aid since this deals with the temporary medicine that could be prescribed for different illness that may affect the ships crew. Inadequate knowledge in this area is a big handicap to this curriculum.

* Emergency Procedures

This topic is related to several other topics (e.g. Ship Safety, Internal Combustion Engine's operation and maintenance, etc.). But engine emergency procedures and other types of emergencies are not dealt with thoroughly in the curriculum. This is very important for the safety of personnel and preventing of damage to machineries.

* Manoeuvering and Ship Handling

(See comment on the PMMA BSMT-ME)

* Steering Gear System

Part of auxiliary machinery on board the ship that is very essential for ship's navigation. Understanding the basic principles of its operation will help a lot in safe operation of the ship. Without knowing the system it will be hard to find the cause in case of malfunction of the system. This is another handicap in this curriculum.

* Detection of Machinery Malfunction, Location of Faults and Action to Prevent Damage to include Vibration Analysis

A marine engineer is employed on board the ship to operate the machinery effectively and economically. He is not there to produce the machinery. Therefore a sound knowledge in the early detection of probable faults is very essential for the economic operation of the ship. This topic is one of the great lapses

of this curriculum.

* Organization of Safe Maintenance and repair Procedures

  It is quite hard to organize the available resources if you don't have the basic knowledge to do so. With the reduced crew on board it is quite hard to always keep track of everything regarding the maintenance requirement of the ships plant. This is a great lapse in the structure of this curriculum that is very important for today's application.

* Additional Requirement for Periodically Unmanned Machinery Spaces

  (See comment in the BSMT-ME)

- With 25% of the needs not covered under this curriculum there is still 25% that is partially covered. This in particular is due to the following:

  * Some subject titles are loaded with so many topics that it makes it difficult to fully discuss and study them to the depth that is necessary.

  * The time allotment on a particular subject is not sufficient.

  * The inadequacy of instructional facilities, as evident in the survey of maritime schools published in Manila Chronicle (February 3,

1989). The instructor has no other way than partially covering the subject required.

In general, we could conclude that the PAMI BSMT-ME curriculum will not fully satisfy todays international maritime needs. This will have a detrimental effect on the future graduates since they will have to face problems on board for which they are not adequately trained.

For the PAMI Associate in Marine Engineering Curriculum

This curriculum has a lot of lapses and handicaps since about 38% of the identified needs of the international maritime community are not covered. Aside from this, about 34% of these needs are only partially covered. This is greater than the 28% that is fully covered under this curriculum. From these figures alone, we could conclude that this curriculum will only produce a marine engineer with inadequate knowledge in his field. Therefore he could not be very competitive in the market. As quoted in the article "Quantity not Quality Characterizes Philippine Education - On the Downgrade" (Far Eastern Economic Review, July 6, 1989) Bernardo Villegas says, "...every index of students skills show a dramatic decline due to the decrease of standards of teaching and the performance of students." We should bear in mind that teaching is part of the product of the curriculum design and teachers usually follow what is prescribed in the curriculum. If there are loopholes in the curriculum design it should not be the teacher that should be blamed. In turn this has a great effect on the performance of the students, not only in the class, but on

performance after graduation.

This curriculum with 38% of the identified needs not covered, is not appropriate to produce a marine engineer that will meet todays shipping needs.

General Conclusion

After considering all the curricula that were looked into in this study, we could conclude that the Marine Engineering curriculum meets the identified needs of the international maritime community in varying degree or level of significance. This will have an effect on the demand of seafarer in the near future if the problem is not rectified immediately.

The Recommendations

Based on the conclusions the following recommendations are formulated;

- Amendments to the PMMA BSMT-ME curriculum should be made.

- Amendments to the PAMI BSMT-ME curriculum should be made.

- The PAMI AME curriculum is recommended to be offered to produce a general purpose crew (Deck and Engine) with amendments to be made.

- To fully optimized the time alloted for each subject the following recommendations are forwarded;
  * A group or a committee from the teaching staff

should be formed to formulate a teaching module. Reference to the model teaching and training modules now published by IMO should be made.

* Improvement of the existing facilities as demanded by the curriculum content.
* Creation of an Audio-Visual Center to help in the production of instructional materials.

- Since we are looking to put into the market a product of high standards, some changes in the Certification system of seafarers should be made in reply to the changes made in the curriculum. The following are suggested to be part of the changes;
  * Inclusion of the basic qualification to take the licensure examination of having a BSMT degree.
  * Streamlining the licensure examination system by;
    a. Updating the questions to correspond to the identified needs of maritime community,
    b. Increasing the Maritime Educators involvement in the conduct of examinations, and
    c. Clarifying properly the right government agency that should conduct the examination.
  * Further study regarding this area should be made.

- Increase number of seminars and symposia for the maritime educators to upgrade their knowledge in the field.

- Conduct a study regarding the possibility of offering a Masters degree in Maritime Education.

- Coduct a study of fully optimizing the resources, and sources of funds of maritime institutions is recommended for the implementation of this curriculum design.

These recommendations stick to the stated significance of this study (Chapter 1) in that it intends to upgrade the existing Marine Engineering curriculum and the quality of product that it is turning out.

The Amendments

As we have stressed in the introduction of this Chapter the amendments will deal with rectifying the problems that exist in the three curricula. We could not deal with this in general so we have to break it into parts.

Taking from the first recommendation, which deals with the Amendments for the PMMA BSMT-ME curriculum, the following topics are focussed upon:

- Topics in Oil and Chemical Tankers, and Liquified Gas Carriers should be included in the curriculum. This could be part of the Seamanship subject since this is closely related. The said subject deals with the introduction of the ships' types and ships' nomenclature that makes it ideal for this topic to be included.

- Manoeuvering and Ship Handling subject should also be included in the curriculum with the addition of rope work, paint works and other closely related topics. An addtion of 2 hours (1 hour

lecture and 1 hour laboratory) could be added to the Seamanship subject.

- The topics on additional requirement for periodically unmanned machinery spaces should be part of the subject title Automation II. This could be handled without additional time allotment.

- The topic in Marine Gas Turbine should be included in the Auxiliary Machinery subject. This could be managed without additional time allotment.

Basically the PMMA BSMT-ME curriculum will remain the same with only an alteration on allotments in Seamanship subject. These are:

SEAMANSHIP 4 Hrs Lecture 1 Hr Laboratory 4 Units

Taking the second recommendation the following amendments are made:

- In the subject title Marine Engineering 312 which covers Steam Engine and Auxiliary, this should be separated into two subjects. The Marine Engineering 312 will cover only the topic in Marine Propulsion Plant with time allotment of 6 hours per week (4 hours lecture and 2 hours laboratory) with a 5 unit load.

  The topic in Auxiliary shall be put under one subject title which will cover the following:

  * Pumping and piping installation
  * Marine gas turbine

* Deck Machinery
* Steering gear systems
* Separators and Filters
* Compressors and pressure vessels
* other closely related topics

This is with at least 4 hours time allotment per week and a load of 4 units per semester.

- In the subject titles Practical Seamanship and Physical Education (111, 121, 211, and 221) are considered under one subject title. These subjects should be separated leaving Physical Education as a separate subject. The Physical Education subject will have a time allotment of two laboratory hours per week with a load of 1 unit per semester.

  The subject Practical Seamanship shall be offered as one subject which will cover the following:

  * Ship types to include oil and chemical tankers, liquified gas carriers, bulk carriers, etc.
  * Ship Nomenclature
  * Manoeuvering and Ship Handling
  * Other closely related topics

  This shall be alloted 5 hours per week (4 hours lecture and 1 hour laboratory) with a load of 4 units per semester.

  The topic in Fire Fighting, Fire Prevention, Survival Craft, Personal Survival at Sea, and other closely related topics shall also be separated. This will be put under the Ship Safety subject. This shall include:

  * Fire Fighting and Fire Prevention

* Survival Craft and Lifeboat
* Personal Survival at Sea
* Safety procedures

This shall have a time allotment of 3 hours per week (1 hour lecture and 2 hours laboratory) with a 2 unit load.

The topic in First Aid shall also be separated and will be offered as one subject to include Medical Care. This will be alloted 1 hour per week with a 1 unit load per semester.

- The subject title Marine Engineering 221 shall be given a follow-up subject which will deal with the following topics:
  * Detection of machinery malfunction, location of faults and action to prevent damage, to include vibration analysis.
  * Planned maintenance
  * Other closely related topics

  This shall be given a time allotment of 5 hours per week (3 hours lecture and 2 hours laboratory) with a 4 unit load.

- The subject title Marine Engineering 314 shall be given a follow-up subject. The ME 314 shall deal with the following:
  * Introduction to Boolean Algebra
  * Control theory
  * Open and closed loop systems
  * Controllers and control valves
  * Pneumatics and hydraulic components
  * Other related topics

  This shall carry an alloted time of 3 hours per week with a 3 unit load.

The supplementing subject shall be designed so it will compliment not only Automation subject but also other related subjects. This subject, at the least, shall deal with:

* Shipboard control system
* Instrumentations
* Additional requirement for periodically unmanned machinery spaces
* Shipyard automation
* Other related topics

This shall have an alloted time of 5 hours per week (3 hours lecture and 2hours laboratory) with a 4 unit load per semester.

- The subject Engineering Economics and Accounting with Land Reform and Taxation 311 shall be separated. Engineering Economics will be offered as a separate subject which will deal with the following topics:

  * Shipping Economic Environment
  * Basic Principles in Accounting
  * Engineering Economy Calculations
  * Application to Ship Design
  * Other related topics

  This will be alloted with 3 hours lecture per week with a 3 unit load per semester.

  Land Reform and Taxation subject will also be offered separately with 3 lecture hours per week, a 3 unit load per semester.

- Under the subject title Marine Engineering 224 which deals with Thermodynamics, the time allotment of 2 lecture hours shall be given an additional 4 lecture hours. With these, the

Thermodynamics subject will be split into 2 subject titles. Marine Engineering 224 will discuss the basic principles in Thermodynamics. This will be alloted 3 lecture hours per week, a 3 unit load per semester.

The supplementing Thermodynamics subject shall be put under a different subject title. This will discuss Thermodynamics application on;

* Internal Combustion Engine,
* Steam Turbine,
* Gas Turbine, and
* Other closely related topics.

This will be alloted 3 lecture hours per week with 3 unit load per semester.

- Under the subject title Marine Engineering 313 which deals with topics on Technical Mechanics and Strength of Materials, the two topics shall be separated.

  The Technical Mechanics subject shall be retained under subject title Marine Engineering 313 with 3 lecture hours per week and a 3 unit load per semester.

  The topic of Strength of Materials shall be offered under a different subject title. This will have an allotment of 3 lecture hours per week and 3 unit load per semester.

- The subject title Ship Business shall be replaced by subject on Inspection and Surveys of Ships. Even though this is not included in the identified needs, a basic knowledge of what the surveyors are looking for during ship inspection is very important for a senior Marine Engineer on board

the ship to have. This shall be alloted 2 lecture hours and 2 laboratory hours per week and a 3 unit load per semester.

- Environmental Science subject shall be introduced to properly cover the MARPOL requirements. This shall be alloted 3 lecture hours per week and a 3 unit load per semester.

- Ship Management subject will be introduced and shall at least deal with:
  * Shipboard Management Sytem,
  * Basic Principles of Management, and
  * other closely related topics.

  This will be alloted 3 lecture hours per week and a 3 unit load per semester.

- The subject title Marine Engineering 122 shall be replace with Metallurgy subject. This will be alloted 2 lecture hours and 2 laboratory hours per week with 3 unit load per semester.

- The topic content of suject title Naval Archeticture 211 will be amended. This will deal with Ship Design and Stability. This will be alloted 3 lecture hours per week with a 3 unit load per semester.

- Under the subject title Marine Engineering 223 which deals with Electrical Engineering (A.C. and D.C.), this shall be separated and will be offered under different subject titles.

  The topic Direct Current shall be offered under one subject title. This will be alloted

2 lecture hours and 2 laboratory hours per week and a 3 unit load per semester.

The topic Alternating Current shall be offered in another subject title. This will be alloted 2 lecture hours and 2 laboratory hours per week with a 3 unit load per semester.

In brief the amended PAMI BSMT-ME curriculum will require at least 5 years to complete. This will consist of 4 years of Academics and 1 year of Shipboard Practice.

The suggested design is as follows:

The Amended PAMI BSMT-ME Curriculum

First Year

First Semester	C	L	U	Second Semester	C	L	U
Mathematics 111	5	-	5	Mathematics 121	3	-	3
PE 111	-	2	1	PE 121	-	2	1
Eng'g. Draw. 111	-	4	2	Eng'g. Drawing 121	-	4	2
English 111	3	-	3	English 121	3	-	3
Pilipino 111	3	-	3	Pilipino 121	3	-	3
Marine Eng'g. 111	-	6	2	Marine Eng'g. 121	-	6	2
Pract. Seaman. 111	4	1	4	Physics 121	3	3	4
Aptitude for Service and Value Edu. 111	-	3	1	Aptitude for Service and Value Edu. 121	-	3	1
NS (CMT) 11	-	-(1.5)		Ship Safety	1	2	2
				NS (CMT) 12	-	-(1.5)	
	15	16	21		13	20	21

Second Year

Mathematics 211	3	-	3	Mathematics 222	3	-	3
PE 211	-	2	1	PE 222	-	2	1
English 211	3	-	3	English 222	3	-	3
Spanish 211	3	-	3	Spanish 222	3	-	3
Physics 211	3	3	4	Thermodynamics 224	3	-	3
Psychology 211	3	-	3	Chemistry	2	3	3
Marine Eng'g. 221	3	2	4	Steam Prop. Plant	4	2	5
NS (CMT) 21	-	-(1.5)		First Aid & Ship Med	1	-	1
				NS (CMT) 22	-	-(1.5)	
	18	7	21		19	7	22

Third Year

Thermodynamics	3	-	3	Electricity (AC)	2	2	3
Naval Arch. 211	3	2	4	Marine Eng'g. 322	2	3	3
Environmental Sc.	3	-	3	Auto. & Control 322	3	-	3
Computer Sc. 311	3	-	3	Marine Eng'g. 313	3	-	3
Social Science 321	3	-	3	Marine ENG'G. 222	3	-	3
Land Reform & Tax.	3	-	3	Marine Eng'g. 211	2	3	3
Electricity (DC)	2	2	3	Aux. Machinery	4	-	4
	20	4	21		19	8	22

Fourth Year

One year Shipboard Practice - 18 units

Fifth Year

Marine Eng'g.(ICE)	3	2	4	Power Plant Design	3	-	3
Strength of Mat'ls.	3	-	3	Eng'g. Economics	3	-	3

Computer Sc. 321	2	3	3	Ship Management	3	-	3
Auto. & Control	3	-	3	Inspection & Survey	3	-	3
Marine Eng'g. 311	2	3	3	Metallurgy	2	2	3
Electrical Systems	3	2	4	Maritime Laws	3	-	3
				Political Sc. 111	3	-	3
	16	10	20		20	2	21

The amended PAMI BSMT-ME curriculum will have a total of 187 units (Including 18 units for shipboard practice), 139 lecture hours, and 74 laboratory hours. The first three years of academics is designed to prepare the students for the shipboard practice. He must have the capability of acting as a Watchkeeping engineer after the one year shipboard practice. The first three years more than satisfied the requirement for a watchkeeping engineer but will fall short of the requirement for Senior Marine Engineers qualification. The last year of Academics is designed for this. This will give a strong foundation in shipping economics, management and surveys. The graduate will have the capability to act as a shipping executive.

Taking the third recommendation, the PAMI AME curriculum shall be designed to produce a General Purpose crew. The first two academic year of the amended PAMI BSMT-ME curriculum will fit this requirement. However, the subject in Environmental Science and Auxiliary Machinery should be part of the requirement. This will take 2 year to finish without shipboard practice.

A student who has finished the first two years of Academics, provided he has taken the additional requirement of Environmental Science and Auxiliary Machinery subjects could be granted a certificate of completion for the Associate in Marine Engineering. This

shall not qualify him to take a licensure examination (at any level) for Marine Engineers.

Strategy of Implementation

Since the conclusions, recommendations, and amendments made to the existing curricula is wide in scope, only the changes to the PMMA BSMT-ME curriculum are relatively easy to implement (Since the authour of this paper is connected to the PMMA). However to implement the changes made at the PAMI BSMT-ME and AME curricula the following steps will be taken:

- Before leaving the World Maritime University, the author of this paper will be able to secure a letter informing various government agencies in the Philippines (DECS, MARINA, etc.) that IMO through WMU has completed the necessary training to assist in upgrading Maritime Education in the Philippines.
- Upon arriving in the Philippines, steps will be taken to convince the PAMI member schools regarding the implementation of this paper (take note that the first step is essential).
- Steps will be taken in formulating the teaching modules. (This step will first be implemented at the PMMA but coordination with the faculty of other maritime schools is necessary once the suggested amended curriculum in this paper is implemented)

In short the implementation of this paper in the maritime education system in the Philippines will take a long process unless enough pressure is put into the concerned agencies.

- E N D -

ANNEX 1

THE PMMA BSMT-ME CURRICULUM

PROFESSIONAL SUBJECT DESCRIPTION

MATHEMATHICS I 1st Year...1st Sem. (5hrs)

Revision of algebraic definitions and processes. Equations (simple, simultaneous, quadratic). Logarithms. Graphs. Measurements of angles and trigonometric relationship. Geometry (lines, angles, circle, construction of triangles).

MATHEMATICS II 1st Year...2nd Sem. (5hrs)

Trigonometry - Solution of triangles. Measuring of areas and volumes. Analytic geometry (line, conic section, circle, ellipse, parabola, hyperbola). Vector geometry. Introduction to differential calculus, concept of function, limits).

MATHEMATICS III 2nd Year...1st Sem. (4hrs)

Derivatives. Differentiation of functions. Maxima and minima, various applications. Introduction to integral calculus. Integration as reverse of differentiation. Simple applications (areas, solids of revolution, 1st moments, centroids, 2nd moments, etc.).

ENGLISH I - SPOKEN ENGLISH 1st Year...2nd Sem. (3hrs)

A speech course which stresses the importance of clear coincise orders and explanations. The use of programmed tape materials enables the student to

compare his progress against standard models.

ENGLISH II 2nd Year...1st Sem. (3hrs)

Reading and interpretation of a wide range of subjects including written machinery instructions, communications procedures and other nautical and engineering information. Extensive use of the library and other technical information sources.

ENGLISH III 2nd Year...2nd Sem. (3hrs)

Principles of clear and concise writing. Exercise in writing technical reports, accident or damage reports, letters and correspondence; also completing standard forms and documents.

CHEMISTRY 1st Year...1st Sem. (class 3hrs. lab. 1hr)

An introduction to the basic principles of inorganic chemistry stressing atomic structure, periodic tables, chemical bonds, chemical equations, gases, liquids, solids, solutions, acids, bases and salts, electro-chemistry, chemical bonds, hydrocarbons. The course is intended as a survey course leading to a practical understanding of fuel combustion, boiler water treatment and analysis, and corrosion.

DRAWING 1st Year...1st Sem. (3hrs)

Plane geometry - First and third angle projection, sectioning, dimensioning, assembly drawings, conventional representation of basic machines elements.

MACHINE SHOP I 1st Year...1st Sem. (class 2hrs lab.4hrs)

Class: Technological properties of materials, production of steel and iron. Use of hand and power tools (files, chisels, hammers, saws, scrapers, taps and dies, drills, grinders). Use of marking and measuring tools (center punch, scribe, calipers, micrometers). Safety in shop.

Workshop: Benchwork (fabrication of simple jobs of mild steel according to drawing, including marking, measuring, filling, sawing, drilling, tapping; accuracy 0.1 mm).

MACHINE SHOP II 1st Year...2nd Sem. (class 2hrs lab.4hrs)

Class: Joining of metals: Soldering, brazing, welding. Machine tools: Turning (lathe details and various uses, cutting speed: thread cutting, tapers-necessary calculations).

Workshop: Electrical and autogen welding. Turning (straight, taper, internal + external threads).

MECHANICS I 1st Year...1st Sem. (3hrs)

Statics: Vector, forces, static equilibrium. Simple framed structures. Centres of gravity. Friction.

MECHANICS II 1st Year...2nd Sem. (3hrs)

Kinematics and dynamics: Linear and angular velocity. Newtons laws of motion. Work, power,

energy. Laws and effeciencies of simple machines.

MECHANICS III 2nd Year...1st Sem. (3hrs)

Hydrostatics: Archimedes principle. Gravity and bouyancy. Fluid pressure. Centre of floatation. Hydromechanics: Flow of incompressible fluids, Eulers equation, Bernoullis equation, impulse, laminar and turbulent flow, Reynold and Froude numbers, dimensional analysis.

THERMODYNAMICS I 1st Year...1st Sem. (3hrs)

S.I. Units, Thermometry. Thermal expansion. Pressure and vacuum, energy, power. Thermodynamic systems, equilibrium, boundaries. Work pV diagram. Heat transfer, simple examples.

THERMODYNAMICS II 1st Year...2nd Sem. (3hrs)

First law: Conservation of energy, internal, kinetic, potential energy, enthalpy. Non-flow processes. Constant volume and pressure, isothermal, adiabatic and polytropic processes. Steady flow processes. Gas laws. Partial pressures, Dalton's law. Universal constant; specific heat of gases. Displacement work of gas and vapour. Air compressors and internal combustion engines. Steam definition of wet, dry, superheated steam, use of tables, calorimeters.

Turbines: Nozzles and blade work.

THERMODYNAMICS III 2nd Year...1st Sem. (3hrs)

Second law: Reversibility and irreversibility, pV, hs, ts diagrams. Efficiency calculations. Combustion of solid, liquid and gaseous fuels. Chemistry of combustion, air requirement, calorific value, exhaust gas analysis. Wet air. Psychometric chart. Air-conditioning. Refrigeration.

ELECTRICITY I 2nd Year...2nd Sem. (4hrs)

Electrostatics + electrochemics; D.C. current; magnetism and electromagnetism; A.C. current. Laboratory 1hr/week.

ELECTRICITY II 2nd Year...2nd Sem. (4hrs)

Measurement. D.C. machines. Transformers. A.C. machines. Maintenance. Safety. Introduction to electronics. Laboratory 1hr/week.

ELECTRIC SYSTEMS I 4th Year...1st Sem. (2hrs)

Marine electrical power and distribution systems. D.C. and A.C. generator operation, switch gear.

ELECTRIC SYSTEMS II 4th Year...2nd Sem. (2hrs)

Marine electric auxiliary machinery, control and measuring devices (deck machinery, steering, refrigeration, auxiliary steam generator, centrifugal separators, pumping systems, cathodic protection, etc.). Marine main engines - electrical control systems (bridge control, engine control

room, monitoring, data logger).

MARINE ENGINEERING-STEAM BOILER 2nd Year...1st Sem.(2hrs)

Elementary steam production: Classifications of boilers; construction and working principles of modern main and auxiliary steam generators; water and fireside equipment including automation and remote controls; measuring instruments: water and fuel treatment, prevention of internal and external corrosion; operation and maintenance; steam on motorship including motor tankers. Safety. (level-STCW, reg. III/4).

MARINE ENG'G. - STEAM TURBINES 2nd Year...2nd Sem.(2hrs)

Principle of simple, compounded and reaction turbines. Constructional details of main and auxiliary turbines. Reduction gearing. Turbine systems: Main Steam; emergency steam; drain; remote control. Closed feed circuits. Condenser, vacuum plant, heat exchangers. Opearation and maintenance. Trouble shooting. (level: STCW, reg. III/4).

INTERNAL COMBUSTION ENGINE (1) 2nd Year...1st Sem. (2hrs)

Nomenclature and classification. 2 and 4 stroke cycles. Supercharging main 2 stroke crosshead. Marine types. Power rating. Construction details: Stationary parts, moving parts. (level: STCW, reg. III/4).

INTERNAL COMBUSTION ENGINE (2) 2nd Year...1st Sem. (3hrs)

Engine systems: Fuel +fuel equipment. Lube oil systems and equipment, fresh water cooling, piston cooling, governing, starting and reversing. Gearing and clutch. Remote control. Operation and maintenance. Safety devices. (level: STCW, reg. III/4).

AUXILIARY MACHINERY 2nd Year...2nd Sem. (4hrs)

Marine pumps: Positive displacement and inertia pumps, principle of work, details of construction, operation, maintenance and trouble shooting. Marine pumping systems (standards, symbols, main lay-outs, valves and instruments.

- compressors and compressed air systems
- Refrigeration (principle, lay-out of ship systems, components, operation).
- Fuel oil and lube oil (properties, test and standards, safety instructions).
- Separators and filters (static and dynamic separator devices).
- Deck machinery (electric, hydraulic, steam).
- Steering engine (telemotor and steering gear, various makers).

SHIPS CONSTRUCTION 2nd Year...2nd Sem. (3hrs)

Nautical nomenclature, classification, general arrangement and transverse section of general cargo and bulk vessels. Constructional details of main components. General safety on board.

SAFETY AND FIRE FIGHTING 2nd Year...2nd Sem. (3hrs)

Lifesaving equipment carried aboard ship and its use. The chemistry of fire. Fire equipment required on board various types of vessels and regulations regarding upkeep, inspection and maintenance of same. Kinds of fires and types of equipment to be used on each kind. Types of fire extinguishers, their use and maintenance. Fire drills, types of fire detection systems. Steam smothering, foam and CO2 systems.

STRENGTH OF MATERIALS 4th Year...2nd Sem. (3hrs)

Tension and compression, bending, shear, torsion, and combined stresses.

FIRST AID AND SHIP MEDICINE 2nd Year...2nd Sem. (1hr)

Emergency care of injuries and illnesses aboard merchant vessels, splinting of fractures, bandaging, treatment of burns. Use of common drugs found in ships medicine chest. Emergency treatment for cardiac arrest, food poisoning, choking and artificial respiration.

MARINE POWER PLANT I 4th Year...1st Sem. (5hrs)

Internal Combustion: Revision of basic cycles. Heat balance and efficiency calculations. Review of latest development in marine diesel production. Waste heat recovery. Reduced speed operation. Planned maintenance. Acute problems (low grade fuel

oil operation, corrosion, surging, vibration, etc.). Annual surveys.

External Combustion: Revision of thermodynamic principles (combustion equations, steam cycles). Boiler heat balance and efficiency calculations. Review of latest development including coal burning. Boiler automation. Turbo-machinery-review of development. Reduced speed operation. Planned maintenance. Heat balance and efficiency calculation of plant. Docking and surveys. (Subject includes tutored study of selected topics, group analysis of problems, utilizing previous sea experience). (Level: STCW, re. III/2).

MARINE POWER PLANT II 4th Year...2nd Sem. (5hrs)

Refrigeration - Revision of basic principles. Improvement of basic cycle. Control and instrumentation. Maintenance and repairs.

Air-conditioning - The basic cycle on psychometric chart. Instrumentation and controls, maintenance and repairs.

Pumping plant - Revision of hydrodynamic principles. Functioning analysis on diagrams. System flow calculation. Pump selection.

Marine transmission - Gear and clutch. Propulsion: Propeller nomenclature: interaction engine /ship, slip, efficiency; speed and fuel calculations. (Level: STCW, reg. III/2).

TRIBOLOGY 4th Year...1st Sem. (2hrs)

Crude oil refining, fuel oil characteristics and tests. Combustion processes. Recent developments on Fuel oil treatment on boardship. Petroleum lubricants - distilling and refining, basic grading + selection, chemical and physical test. Elements and principles of lubrication. Reconditioning.

METALLURGY 4th Year...1st Sem. (4hrs)

Class: Review - Iron and steel production. Testing; solidification of ferrous metals; equilibrium diagrams; heat treatment; alloy steels and irons; non-ferrous metals and alloys; polymers. Marine metallurgical aspects (corrosion; fatigue; creep; etc.).

Laboratory: Tensile, impact, hardness test. Heat treatment. Micro-examination. Visit of foundry and steel mill.

ECONOMICS AND MANAGEMENT 4th Year...1st Sem. (5hrs)

Shipping companies' organization and operation. Shipboard organization. National and international organizations of the maritime industry. Cargo and liner conferences. Labor organization, contracts of employment. Basic economic concepts. Ships' finance and financial structure of a shipping company. Revenue, balance sheet, profit and loss. Budgetary control.
Planned maintenance - systems and controls, case

studies, solutions and strategies.

AUTOMATION I 4th Year...1st Sem. (class 2hrs. lab. 1hr.)

Pneumatic and hydraulic components and control systems. Control theory. Open and closed loops. Controllers and control valves.

AUTOMATION II 4th Year...2nd Sem. (class 3hrs. lab. 1hr.)

Shipboard control systems; Instrumentation; Introduction to computer science, applied basic programming.

ELECTRONICS 4th Year...1st Sem. (class 2hrs. lab. 1hr.)

Thermionic emission. Diodes, triodes, semi-conductors. Rectifiers. Thyristors. Simple logic systems for control.

MACHINE DESIGN I 4th Year...1st Sem. (3hrs)

Revision of drawing fundamentals. Limits and fits. Intersections and development. Standards. Calculation, design and drawing of fixed and removable machine fastenings. Thick and thin walled cylinders. Shaft, key, spring.

MACHINE DESIGN II 4th Year...2nd Sem. (3hrs)

Transmission (gearing; belt drive, chain drive, friction clutch). Slide and antifriction bearing. Designing and drawing of simple mechanical devices. Preparation of assembly drawings from sketches of

various marine machinery.

MARITIME LAW 4th Year...2nd Sem. (4hrs)

History and development of admiralty and maritime jurisdiction. Laws governing carriage of goods at sea. Rights of sailors. International maritime organizations and conventions. Philippine Coast Guard Rules and Regulations. Classification societies. Safety codes for construction, operation and survey of hull and machinery.
Insurance - Basic principles, types of marine policies. Collision, salvage, general average, limitation of liability. Vessels certification and documents.

ENVIRONMENTAL SCIENCE 4th Year...2nd Sem. (2hrs)

Pollution of marine environment by oil, sewage, garbage, industrial waste, etc.. Sources, effects, methods of control. Ships' anti-pollution arrangements. International and local laws against pollution.

NAVAL ARCHITECTURE 4th Year...2nd Sem. (3hrs)

Ship geometry, areas, volumes and displacement: Transverse static stability at small and large angles. Trim. Use of hydrostatic information. Rudders. Strength of ships.

ANNEX 2

THE PAMI BSMT-ME AND AME CURRICULUM

SUBJECT DESCRIPTION

DRAWING 111 1st Year...1st Sem. (6hrs. Laboratory)

Engineering Drawing I

Use of instruments. Lettering. Geometrical construction. Dimensioning and scaling. Multiview projection and isometric. Sectional view and oblique view. Topographical drafting.

DRAWING 121 1st Year...2nd Sem. (6hrs. Laboratory)

Engineering Drawing II

Auxiliaries (Auxiliary views, right and left auxiliary, inspection revolutions, front and rear auxiliary, oblique auxiliary). Intersections and development (Prisms, cylinders, spheres, etc.). Threads and fasteners. Working drawings. Charts, graphs and diagrams. Layouts and structural drafting.

MATHEMATICS 1st Year...1st Sem. (5hrs. Lecture)

College Algebra and Plane Trigonometry

Review of elementary algebra. Linear equations. Factoring. Fractions. Exponents and radicals. Quadratic equations. System of equations involving quadratics. Inequalities. Mathematics induction and the binomial formula. Progression. Complex numbers. Theory of equations. Logarithms. Permutations and combinations. Determinants. Partial fractions. Infinite series. Trigonometric

functions. Solutions of right triangle. Logarithms and its application to trigonometry. Graphs or trigonometric functions. Fundamental identities and equations. Radian or circular measures; inverse trigonometric functions. Solution of oblique triangle. Elementary plane vectors.

MATHEMATICS 121 1st Year...2nd Sem. (3hrs. Lecture)

Analytic Geometry

Cartesian coordinates. Curves and functions. Equations of a locus. The straight line. The circle. Conic selections - Parabola, Ellipse, and Hyperbola. The general equations of a second degree (rotation of axes). Tangents and normal to the conics. Polar coordinates. Parametric equations. Families of curves. Curve fitting. Solid analytic geometry.

MATHEMATICS 211 2nd Year...1st Sem. (3hrs. Lecture)

Differential Calculus

Functions, limits, and continuity. Differentiation and application. Differentiation of algebraic functions. Equation of the second degree - Circle, Parabola, Ellipse, and Hyperbola. Differentiation of tramscedetal functions. Parametric equations, curves and roots. Polar coordinate. Differentiation with respect to time. Indeterminate forms. Curve tracing. Partial differentiation.

MATHEMATICS 222 2nd Year...2nd Sem. (3hrs Lecture)

Integral Calculus

Integration of powers - Indefinite integrals. Definite integrals; fundamental theorems; plane areas in rectangular coordinates; volume of solids of revolution. Moments of mass; centroids of plane areas; fluid pressure work. Integration formulas and procedures, powers, exponential functions, trigonometric functions, substitution, etc.. Length of plane curves, area of surface of revolution, volume of soilids with known cross-section. Hyperbolic functions. Integration and partial fractions. Multiple integrals (double and triple integration). Approximate integration. Infinite series.

CHEMISTRY 111 1st Year...1st Sem. (2hrs. Lec. 3hrs. Lab.)

General Chemistry

Chemical concepts; scientific measurements. Atomic structure and periodic table. Electronic structure of atoms: Atomic spectra; ionization energies/energy sublevels,atomic orbital and quanum numbers. Chemical changes and chemical bonds; Chemical changes, bond energies, electrovalent and covalent bonds, electronegativity, size of atoms, ions and molecules. Formulas and equations; Classes of compounds, oxidation numbers, systematic naming of compounds, chemical equations, mole, energy, changes accompanying chemical reactions, classification of compounds, acids, bases, slats, neutralization.

PRACTICAL SEAMANSHIP AND PHYSICAL EDUCATION 111 1st Year ...1st Sem. (3hrs. Laboratory)

Basic swimming and floating. Practical instruction in ropes, wires, knots, hitches, bends, splices, and riggings (actual knot tying). Canvas works. Physical fitness and self-testing activities.

PRACTICAL SEAMANSHIP AND PHYSICAL EDUCATION 121 1st Year ...2nd Sem. (3hrs. Laboratory)

Fire fighting. First aid at sea. Swimming styles and diving. Varitation of basic aquatic skills.

PRACTICAL SEAMANSHIP AND PHYSICAL EDUCATION 211 2nd Year ...1st Sem. (3hrs. Laboratory)

Elements of damage control: Fire, collision, grounding, battle action. Emergency drills, signals, and station bills: Fire, abandonship, lowering of lifeboat, man overboard. Abandoning ship (Hot or cold climate): Personal survival equipment, personal survival techniques, distress signal equipment, food and water rationing. Lifeboat and liferaft handling: Lifeboat and liferaft handling, lifeboat and liferaft marking, lifeboat davits, rules of the road, surfing and beaching. Actual application: Rowing and sailing of lifeboat and liferaft, righting-up of liferaft (inflatable). Individual/dual sports.

PRACTICAL SEAMANSHIP AND PHYSICAL EDUCATION 221 2nd Year ...2nd Sem. (3hrs Laboratory)

Tanker safety procedures. Inert gas system. Crude oil washing. Pollution prevention. Team sport.

APTITUDE FOR SERVICE 111 1st Year...1st Sem. (3hrs. Lab.)

Introduction (Aptitude for Service I). Value Education(Books 1 and 2). School of Code of Discipline. Stand watch as; JOD, SOD. Flag ceremony and retreat.

APTITUDE FOR SERVICE 121 1st Year...2nd Sem. (3hrs. Lab.)

Principles of human relations and leadership. Value education (Books 3 and 4). Stand watch as; JOD, SOD. Flag ceremony and retreat.

ENGLISH 111 1st Year...1st Sem. (3hrs. Lecture)

Communication Arts

Communication for today: The communication process, communication for today, use of dictionary, selected reading. Structural grammar for today: A thumbnail history of grammar, essential contrast between traditional and structural grammar, transformational generative grammar; Basic statement pattern, question pattern, statements and tag question, request and commands, connected statements; Selected reading for today. Form classes and structures words: The structure of English; Form classes and function words; Function of structure words;

Selected reading for today. Sentence craft: Immediate constituents of the sentence subject and predicate; Recognizing function units in sentences; Selected reading for today.

ENGLISH 121 1st Year...2nd Sem. (3hrs.Lecture)

Intermediate Communication

Review of fundamentals: Developing diction through word choice and arrangement; Achieving communicative competence through syntactic, structure on discourse level. Study skills for composition writing: Summarizing; Outlining; Critical reading. The paragraph as composition: Structural elements and essential qualities; Writing a paragraph according to types of discourse. The composition as a theme: The nature of composition; Rudiments of theme writing; Methods of development; Aids to organization. The research paper: Steps in preparation of a term paper; Format; Documentation.

ENGLISH 211 2nd Year...1st Sem. (3hrs. Lecture)

Business English and Correspondence

Introduction to Business English: The framework of effective communication; The Psychology of effective writings; Writing skills and job success; Making business letters effective. The business letter form: Quality effective letters; Business letter form. Everybody business letters: Letters that ask (inquiry); Transmittal; Acknowledgement (inquiry, order, remittance). Letters for problem situations: Claim; Adjustment; Credit; Collection; Sales. Employment letters: Application; Letter requesting

permission for reference. Office correspondence and reports: Public relation letters; Social-business letters; Memorandum; Telegrams, minutes and news releases.

ENGLISH 222 2nd Year...2nd Sem. (3hrs Lecture)

Technical Report Writing

What is technical report writing? Basic aspects of technical report writing. Five basic principles of good technical report writing. Style in technical report writing. Outlines and abstracts. Definitions. Description of mechanism. Description of a process. Transitions, introductions, and conclusions. Classification and partition. Types of report. Report layout. The library research report.

MARINE ENGINEERING 111 1st Year...1st Sem. (6hrs. Lab.)

Mechanical Shop Practice I

Tool classification and their uses. Safety precaution in the shop. Bench work: Hard and power hacksaw cutting procedures of operations; Files and filing procedures of operations; Hammers and hammering; Pattern work. Welding process: General condition for welding; Forge welding; Electric-arc welding; Oxy-acetylene welding; Soldering Process. Heat treatment of steel. Forge work. Grinder. Metal casting.

MARINE ENGINEERING 121 1st Year...2nd Sem. (6hrs. Lab.)

Mechanical Shop Practice II

Machine classification and their uses and operation. Safety precaution in the machine shop. Measuring instrument and gauges. Lathes, lathe work and lathe tools. Shapers and planer.

PHYSICS 121 1st Year...2nd Sem. (3hrs. Lec. 3hrs. Lab.)

LECTURE:

Introduction to course. Mechanics: Vector, forces, equilibrium, moments; Velocity, acceleration, force and motion, Newton's law of motion, rectilinear motion, projectiles; Friction, energy, work and power, torque and rotation, impulse and momentum; Simple harmonic motion, elasticity, vibration motion; Hydrostatic and hydronamics. Heat: Temperature measurement and thermal expansion; Heat effects and measurement, heat transfer; Basic concepts and laws of thermodynamics. Sound: Wave, motion, sound waves, accoustics.

LABORATORY:

Measurements, accuracy, precision, data analysis. Force component and addition. Moments of force. Rectilinear motion. Newton's second law. Determination of "g". Centrepetal force. Conservation of energy. Elastic and inelastic collision. Moduli of elasticity. Moment of enertia. Simple pendulum. Simple harmonic motion. Resonance tube. Thermal expansion of metals. Specific heat. Latent heat of fusion and vaporization. Boyle's law.

PHYSICS 211 2nd Year...1st Sem. (3hrs. Lec. 3hrs. Lab.)

LECTURE:

Electricity and magnetism: Electric charges and fields, electric potential, current and resistance, Coulombs law; Electric circuits, characteristics of DC circuits; Electric power and energy; Magnetic effects of electric current, electric instruments, magnetic properties, magnetic circuit; Induced EMF, Electromagnetic induction, capacitance and dielectrics; A.C. series circuits; Conduction in gases, electronics. Light and optics: Nature of propagation of light, illumination; Reflection and refraction of light; Dispersion and spectra; Interference and diffraction; Polarized light.

LABORATORY:

Coulomb's law. Ohm's law. Wheatstone bridge. Joule's law - Electric power work. EMF of a cell, terminal voltage, internal resistance. Potentiometer. Series and parallel resistors. DC Meter, construction of voltmeter/ammeter. Measuring resistance and power by voltmeter/ammeter. Lenz' law and transformer. DC Generator and AC motor. R.L. Circuit. R.C. Circuit. Index of refraction. Reflection by plane and spherical mirrors. Thin lenses. Prism spectrometer. Diffraction grafting spectrometer.

NAVAL ARCHITECTURE 211 2nd Year...1st Sem. (2hrs. Lecture 3hrs. Laboratory)

Basic Naval Architecture with ship nomenclature.

MARINE ENGINEERING 221 2nd Year...2nd Sem. (3hrs. Lecture 6hrs. Laboratory)

Internal Combustion Engine

Classification of the different kinds of ICE with regards to the methods of charging, speed, design, and kind of fuels used. A study of properties of fuels used by ICE. Calculations of air requirements for compound gases. A study of the different theoretical cycles. A study of the handling of volatile liquid fuels. A study of the handling of fuel oils. Calculations of the work of the different kinds of fuel injection pumps. A study of the engine performance. The effect of athmospheric conditions on the performance of the ICE. A study of the performance of the four stroke cycle compression ignition engine. A study of the performance of the two stroke cycle engines. Engine efficiencies. Engine design. Engine heat balance. Engine testing.

ENGINEERING ECONOMICS/ACCOUNTING 311 3rd Year...1st Sem. (3hrs Lecture)

The business side of engineering. Principles of and problem on compounded interests, annuities, and sinking fund. Engineering economy, development and promotion. Cost, construction cost, investment, depreciation cost, depletion, decision making. Estimating first, valuation or appraisal estimating cost. Basic model for decision making, the annual cost model, the minimum cost model. Financial

analysis, the intangible analysis, size and use economy, the break-even analysis. Problem of replacement, some aspects of public work, discussion of continuing problems. Principles of accounting, simplified bookkeeping, book of accounts and records, the two basic accounting system, financial statements. Taxation defined: kinds of taxes, tax laws, tax exemptions, income taxation, deduction allowed, payment of taxes. History of land reform, land reform in the Philippines, Land Reform Code, Agencies created to implement land reform and the farmer.

SHIP BUSINESS 321 3rd Year...2nd Sem. (3hrs. Lecture)

Ships' papers and documents. Ships' business with Port officials. Requirement for Port of Entry and vessel clearance. Port activities. Crew and passenger obligations. Business with agents and charterers.

COMPUTER SCIENCE 311 3rd Year...1st Sem. (3hrs. Lecture)

Computer Programming Fundamentals I Introduction to data processing. Computer and computer systems. Number systems and data requirements. Computer hardware. Computer software. Personnel. Procedures. Problem analysis and solution design.

COMPUTER SCIENCE 321 3rd Year...2nd Sem. (2hrs. Lecture 3hrs Laboratory)

Computer Programming Fundamentals II

Data organization. Data manipulation. Computing strategies. File handling. Introduction to system analysis and design.

MARINE LAWS 324 3rd Year...2nd Sem. (3hrs. Lecture)

Rules and regulations for merchant vessels of the Philippine registry. Admiralty law. Marine Insurance. Environmental preservation.

MARINE ENGINEERING 323 3rd Year...2nd Sem. (1hr. Lecture 2hrs Laboratory)

Shipboard instrumentation and control devices. Electrical distribution on engineering machinery.

MARINE ENGINEERING 322 3rd Year...2nd Sem. (2hrs. Lecture 3hrs. Laboratory)

Electronics Technology.

MARINE ENGINEERING 321 3rd Year...2nd Sem. (2hrs. Lecture 3hrs. Laboratory)

Power Plant Design.

MARINE ENGINEERING 314 3rd Year...1st Sem. (3hrs. Lec.)

Shipyard Automation: Hydraulics; Pneumatics.

MARINE ENGINEERING 313 3rd Year...1st Sem. (3hrs. Lec.)

Technical Mechanics. Strength of Materials.

MARINE ENGINEERING 312 3rd Year...1st Sem.
(3hrs. Lecture 6hrs. Laboratory)

Steam engine and auxiliaries.

MARINE ENGINEERING 311 3rd Year...1st Sem.
(2hrs. Lecture 3hrs Laboratory)

Shipyard Practice. Ship Maintenance and Hull Preservation.

MARINE ENGINEERING 224 2nd Year...2nd Sem. (2hrs. Lec.)

Thermodynamics.

MARINE ENGINEERING 223 2nd Year...2nd Sem.
(2hrs. Lecture 3hrs. Laboratory)

Electrical Engineering: Direct Current; Alternating Current.

MARINE ENGINEERING 222 2nd Year...2nd Sem. (3hrs. Lec.)

Fuel, oils, and lubricants.

MARINE ENGINEERING 211 2nd Year...1st Sem.
(2hrs. Lecture 3hrs. Laboratory)

Refrigeration.

MARINE ENGINEERING 122 1st Year...2nd Sem. (2hrs. Lec.)

Engineering Materials.

ELECTRICAL ENGINEERING 211 2nd Year...1st Sem. (AME)
(2hrs. Lecture 3hrs Laboratory)

Elements of Electrical Engineering - D. C.

ELECTRICAL ENGINEERING 221 2nd Year...2nd Sem. (AME)
(2hrs. Lecture 3hrs. Laboratory)

Elements of Electrical Engineering - A. C.

MARINE ENGINEERING 211 2nd Year...1st Sem. (AME)
(3hrs. Lecture 6hrs. Laboratory)

(See subject description of ME 221 of BSMT-ME)

COMPUTER 111 2nd Year...1st Sem. (AME) (2hrs. Lecture 3hrs Laboratory)

Basic Computer system.

MARINE ENGINEERING 221 2nd Year...2nd Sem. (AME)
(3hrs. Lecture 6hrs. Laboratory)

(See subject description of ME 312 of BSMT-ME)

MARINE ENGINEERING 223 2nd Year...2nd Sem. (AME) (2hrs. Lecture)

Merchant marine rules and regulations.

MARINE ENGINEERING 224 2nd Year...2nd Sem. (AME) (1hr. Lecture 3hrs. Laboratory)

Ship Drafting.

MARINE ENGINEERING 225 2nd Year...2nd Sem. (AME) (2hrs. Lecture 3hrs. Laboratory)

Engineering Materials.

MARINE ENGINEERING 215 2nd Year...2nd Sem. (AME) (2hrs. Lecture 3hrs. Laboratory)

Marine Refrigeration and Airconditioning.

COMPUTER 122 2nd Year...2nd Sem. (AME) (2hrs. Lecture 3hrs. Laboratory)

Basic Computer Programming.

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