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Marine engineering training in Myanmar

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MARINE ENGINEERING TRAINING IN MYANMAR

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A paper submitted to the Faculty of the World Maritime University in partial satisfaction of the requirements for the award of a Master of Science Degree in

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

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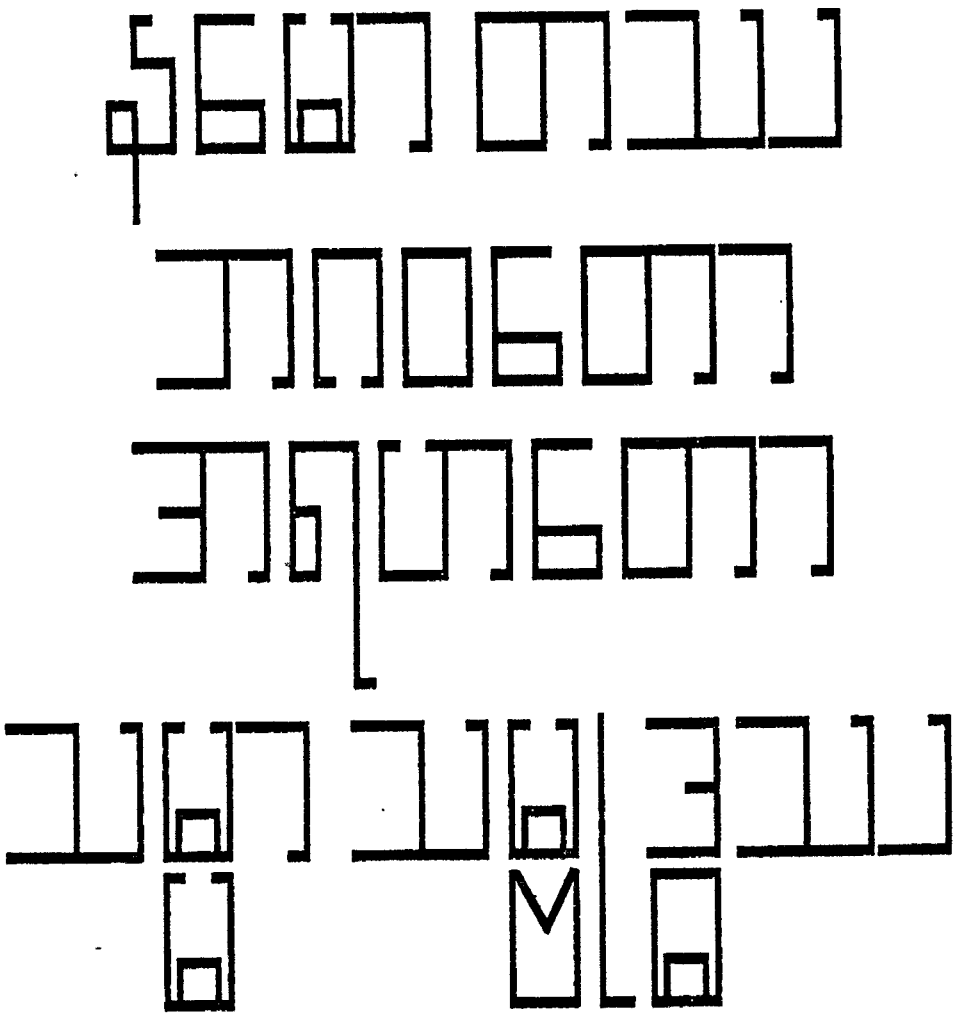

HOMAGE TO HIM,

THE BLESSED ONE,

THE HOLY ONE

AND

THE FULLY ENLIGHTENED ONE

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DEDICATION

To my beloved wife Sann, our son Mg Tharr and our daughter May Swe

ABSTRACT

The present system of maritime education and training for engineers in Myanmar has existed since 1963. It is very close to the old British system of maritime training. Marine engineers trained in this way have been found to be competent and qualified in their profession. Despite this satisfactory achievement, it is necessary to modify the existing training system to keep abreast with the changing global system and developing standards.

The purpose of this study is to highlight the maritime education and training system presently used in Myanmar and to propose some modifications needed to comply with international standards.

This paper contains seven chapters. Four of them present the current situation in Myanmar: They cover the Shipping Industry, the implementation of International Conventions and the Training and Examination systems used for maritime personnel. In Chapter 4 a comparison is made between existing training syllabi and STCW 1978 minimum requirements. Chapter 6 deals with the Maritime Education and Training programs of several countries which have modern systems.

Recommendations, which are my own views, are made in the last chapter. They come from knowledge gained during my two years of study at the World Maritime University.

With the approval of the authorities concerned, this study paper could provide guidance in improving the Myanma marine engineering training system.

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INTRODUCTION

The promotion of acceptable standards for the construction and equipment of ships and for their inspection, survey and certification are important for safeguarding maritime safety. But they alone are not sufficient for this purpose. The qualification of seafarers is the crucial element in ensuring higher standards of maritime safety and pollution. Investigations into shipping casualties have shown that an extremely high percentage of their causes may be attributed to human failure resulting from lack of qualification or negligence. A ship is only as good as the men who man it. With the continuing technological development in shipping, the equipment fitted on board improves the efficiency of running of the ships. But on the other hand, responsible persons operating these machineries and equipment need to be trained so that they can be able to handle them with required skill and intelligence. No matter how sophisticated the equipment available on board today's ship might become, the safety of ships will ultimately depend upon their crews and their professional ability and dedication. Seafaring today, in the days of automation, radar observation and collision avoidance instrumentation, engine controls, etc., is a highly skilled profession. The education and training of seafarers to meet the ever growing demands of a changing maritime industry is a challenge which must be faced and overcome by maritime nations. The complexity of knowledge that seafarers must possess in order to ensure safe operation of ships has grown dramatically. It is obvious, therefore, that the training of maritime personnel must be given high priority.

Apart from the above observation, the training of seafarers improves safety standards and efficiency, both of which are vital. A seafarer on watch with inadequate or no training might lead to serious hazards or casualties and impose danger and threat to ships in the vicinity. Trained seafarers of a country would in fact increase the employment potential of seafarers of that country in the long run particularly because:

- Shipowners at large are becoming keen on employing more highly trained seafarers.
- Maritime Governments are becoming particular about effectively trained seafarers being employed on their ships.
- Among developing nations, who need employment for their seafarers in foreign-flag ships, preference of the employers would, in the long run, be for the best trained seafarers.
- Qualified and/or specialized manpower when made available to foreign countries and/or firms, may gradually become an important service offered abroad, and hence a foreign exchange earner.

Since its inception, the International Maritime Organization (IMO) has recognized the importance of human resources to the development of the maritime industry. It has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. Many developing countries are establishing systems of certification and training in response to the International Convention on the Standards of Training, Certification and Watchkeeping (STCW) 1978 requirements. They receive advice in these matters from IMO to update

their maritime education and training standards. Other countries are still using their existing systems.

The Union of Myanmar is practicing its own system which is very close to the old British system of maritime training, as this system is familiar to the country. The training programme for the Merchant Naval personnel was established in the Union of Myanmar in 1963, and is reviewed periodically. Standard of training achieved in the Union of Myanmar is found to be acceptable in International Shipping as Myanma seafarers are still found to be competent and favored by foreign shipping companies. Despite this satisfactory achievement, it is necessary to make a continuous effort to bring the training in line with the latest developments in world shipping and ensure compatibility with the global system and standards.

In preparing this study paper, the present condition of the Myanma Shipping Industry, how it is implementing the International conventions and what kind of training and examination system it uses for maritime personnel will be discussed. These will allow the people who read this paper to become familiar with the system used in Myanmar and the present status of the country's marine industry. The paper will emphasize what is necessary or which parts are required to modify to improve the present system to meet the present day's international standards.

Then a comparison will be made between the STCW 78 Convention requirements and the teaching syllabi presently used for Maritime Education and Training in Myanmar to find out which parts in the Myanma syllabi are necessary to develop further or which parts require modification. To be competitive with the other countries to get more

employment in the foreign shipping companies and to earn more foreign exchange for the country, the standard of the Myanma Maritime Education and Training system is required not only to meet the minimum requirements of the STCW 78 Convention, but to exceed these requirements.

Also various Maritime Education and Training systems of some countries will be highlighted. The objective is to find out which parts of the programmes in advanced countries are best suited to our own local needs. There is a necessity for continuous modifications and adjustments in the system or its components in efforts to meet the changing demands occurring in the maritime field.

CHAPTER 1

MARITIME BACKGROUND

1.1 Facts on the Union of Myanmar

1.1.1 Geography

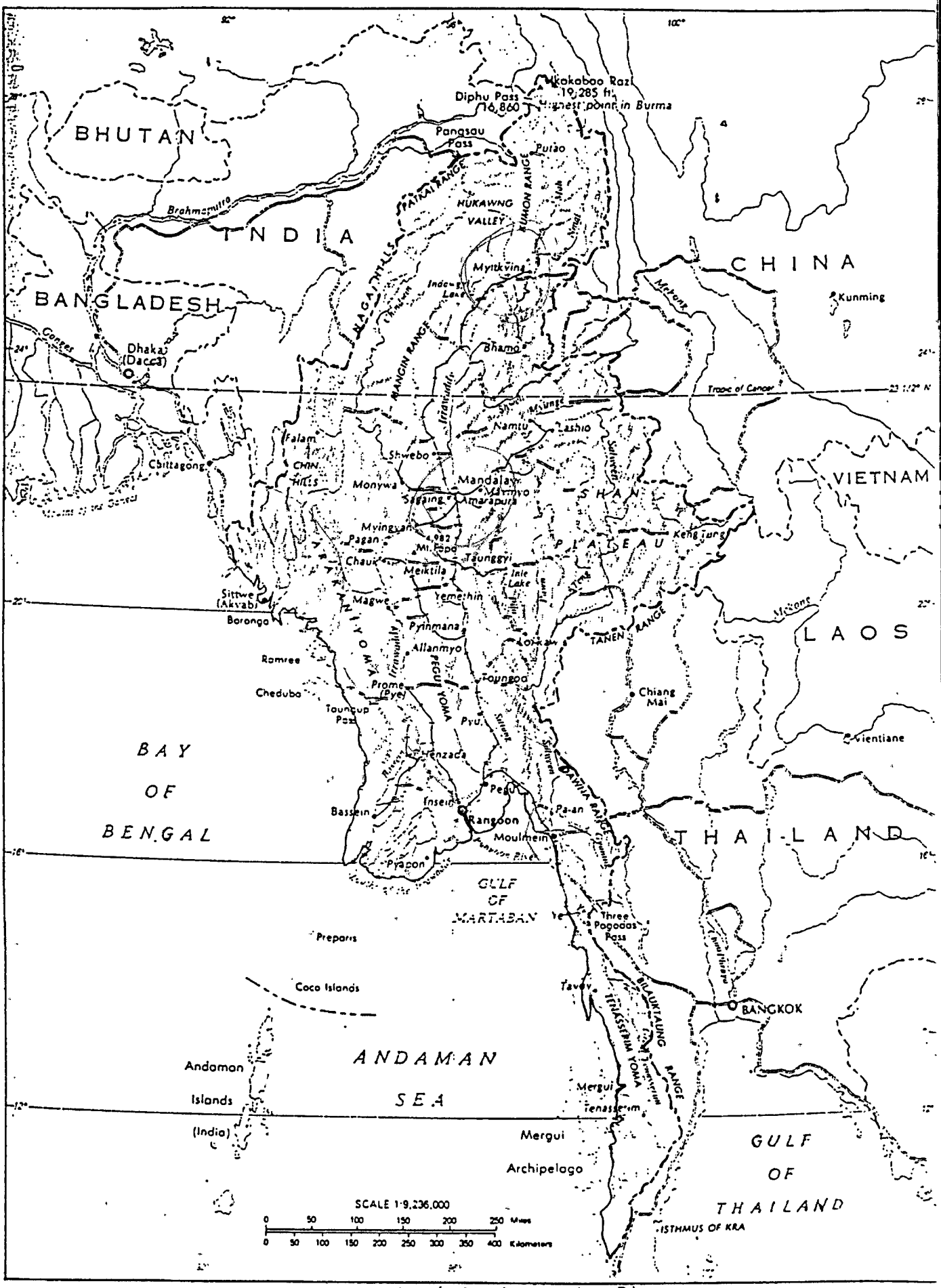
The Union of Myanmar is situated in Southeast Asia and is bordered on the north and northeast by China, on the east and southeast by Laos and Thailand, on the south by the Andaman Sea and the Bay of Bengal and on the west by Bangladesh and India (see Figure 1a). The country covers an area of 677,000 square kilometres (261,228 square miles) in the shape of a diamond. There are 925 kilometres (575 miles) from east to west and 1931 kilometres (1200 miles) from north to south. It comprises seven states, which are Kachin State, Kayah State, Karen State, Chin State, Mon State, Rakhine State and Shan State, and seven divisions, which are Sagaing Division, Tenasserim Division, Pegu Division, Magwe Division, Mandalay Division, Yangon Division and Irrawaddy Division (see Figure 1b). It is a land of hills and valleys and is rimmed in the north, east and west by mountain ranges forming a giant horseshoe. Enclosed within the mountain barrier are the flat lands of Irrawaddy, Chindwin and Sittaung river valleys where most of the country's agriculture land and population is concentrated.

1.1.2 Location

The location of the Union of Myanmar is between latitudes 9 degrees 32 minutes north and 28 degrees 31 minutes north, and longitudes 92 degrees 10 minutes east and 101 degrees 11 minutes east. The Tropic of Cancer passes through the country close to Tiddim, Tagaung and Kutkai towns. East longitude 96 degrees 13 minutes and north

Figure (1)(a)

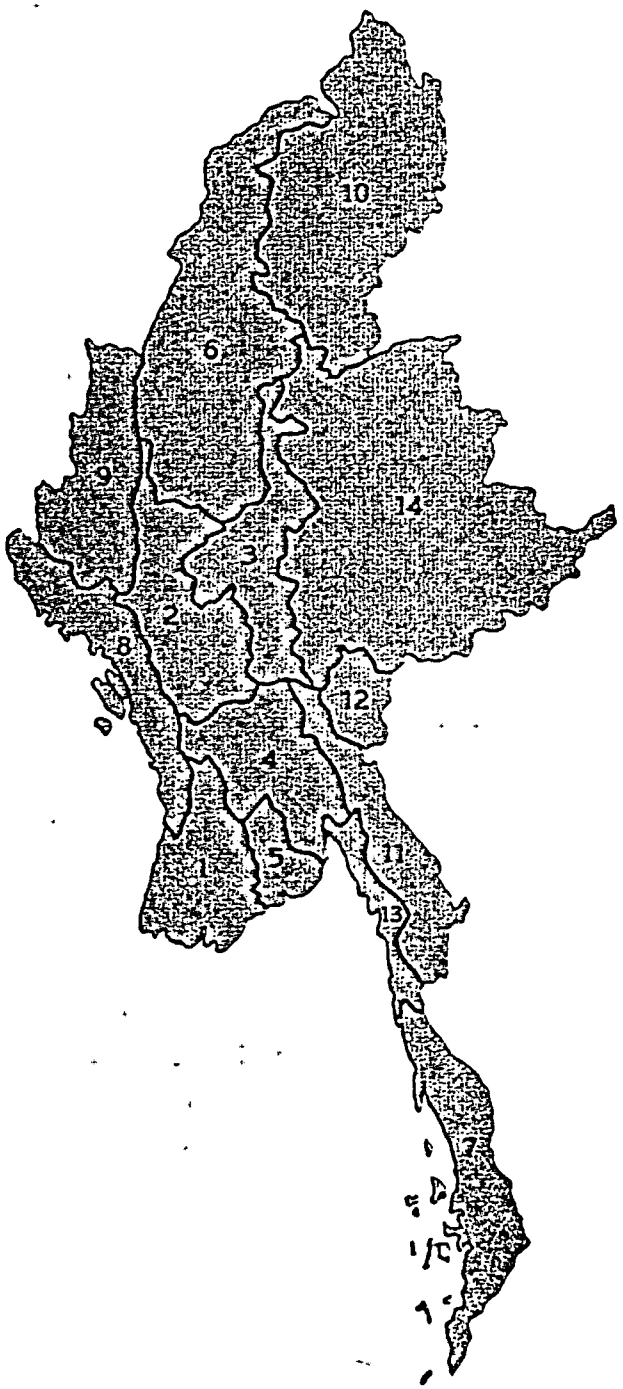
Map of the Union of Myanmar



Source: Atlas of Southeast Asia (Bibliography 9)

Figure (1)(b)

DIVISIONS AND STATES



Divisions
1. Irrawaddy
2. Magwe
3. Mandalay
4. Pegu
5. Rangoon
6. Sagaing
7. Tenasserim

States
8. Arakan State (Rakhine State)
9. Chin State
10. Kachin State
11. Karen State
12. Kayah State
13. Mon State
14. Shan State

Source: Atlas of Southeast Asia (Bibliography 9)

latitude 16 degrees 45 minutes run through Yangon, the Capital of the Union of Myanmar. The Myanma Standard Time, taken as on east longitude 97 degrees 30 minutes, is six hours thirty minutes ahead of the Greenwich Mean Time. The length of contiguous frontier is 5858 kilometres (3639 miles) and the coast line from the mouth of Naaf River to Kawthaung is 2276 kilometres (1414 miles).

1.1.3 Climate

The climate of Myanmar is roughly divided into three seasons:

- Summer, with highest temperature during March and April in Central Myanmar up to about 43.3 degrees Centigrade and on the Shan plateau between 29.4 degrees and 35 degrees Centigrade.
- Rainy season, from May to end of October, with annual rainfall of less than 40 inches in Central Myanmar while the coastal regions of Rakhine and Tenasserim get about 200 inches.
- Winter which starts from November to the end of February where temperature in hilly areas with an elevation of over 3000 feet drops below 0 degrees Centigrade.

As a whole, the location and topography of the country generate a diversity of climate conditions. Seasonal changes in the monsoon wind directions create summer, rainy and winter seasons. The directions of winds and depression bring rains, and in some years severe storms occur causing damage in the Rakhine region. In Rakhine and Tenasserim regions, rainfall varies from year to year. Though it is always heavy it creates no hardships.

Monthly Average Temperature in Yangon(Degrees Centigrade)

Jan.	Feb.	Mar.	April	May	June
19	23	29	32	33	33
July	Aug.	Sep.	Oct.	Nov.	Dec.
32	32	30	28	18	16

1.1.4 Basic Educational System in the Union of Myanmar

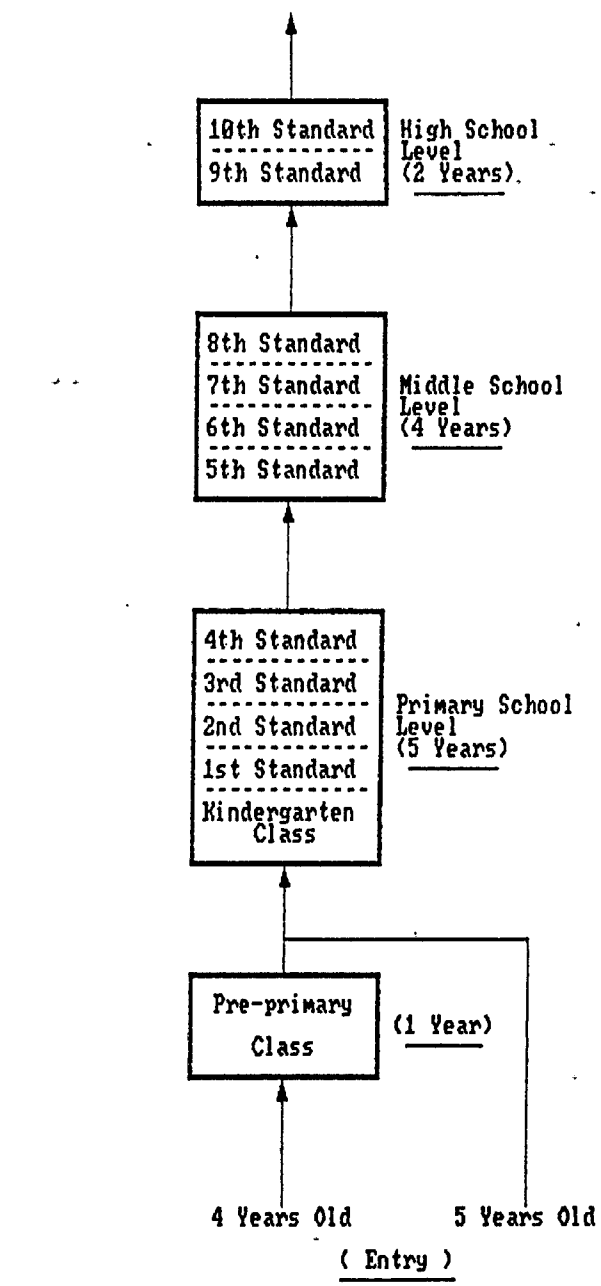
The basic educational system, laid down by the Basic Educational Department which is under the Ministry of Education, is divided into three levels (see Figure 2). They are the primary level, the middle level and the high level. The primary level is compulsory for all people in the country and the minimum age to start this level is five years old. There is a class which is called Pre-primary class, which is not compulsory for all people, held under the auspices of the Ministry of Social Welfare and the minimum age required to attend this class is 4 years old. The primary level contains Kindergarten class and First to Fourth Standard classes. The middle level contains Fifth to Eighth Standard classes and the high level contains Ninth and Tenth Standard classes. The final examinations of the final classes of every level which are the fourth, eighth and tenth standards are held in national standard. Other examinations of these classes and all of the other classes are made by the schools. After passing the Tenth Standard the students can select the universities or other professional courses they want to attend according to the marks they obtained in the examination.

1.2 Merchant Shipping

In Myanmar, merchant shipping is under the charge of the Department of Marine Administration which is one of the departments of the Ministry of Transport and

Figure (2)

BASIC EDUCATIONAL SYSTEM IN THE UNION OF MYANMAR



Communications. The Department of Marine Administration is the specialized executive arm of the government to implement the regulatory functions embodied in the national maritime legislation. The most vital functions of this department are those intended to ensure the Safety of Life at Sea, Safety of Navigation and Protection of the Marine Environment. The Director General of this department has been delegated power to enable him to perform effectively the various functions under the Burma Merchant Shipping Act, Burma Registration of Ships Act and various notifications related to the shipping matters. These acts and notifications include registration of ships, measuring of tonnage of ships, surveying and issuing of safety certificates, and conducting of examinations of seafarers.

1.3 Ports

Myanma Ports Authority is an organization under the Ministry of Transport and Communication and its operational functions are:-

(a) providing pilotage service
(b) maintenance of light houses, light vessels and light buoys
(c) cargo handling, such as providing stevedores, equipment, etc.
(d) providing agency services to visiting ships
(e) maintenance of berths
(f) dredging harbours, berthing areas, fairways and approaches
(g) providing the issuance of Deratting / Deratting exemption certificates by the health division of the Myanma Ports Authority, and
(h) other various matters relating to the ports.

1.4 National Shipping Fleet

The categories and numbers of ships registered at the Department of Marine Administration at present can be summarized as:-

(a) The State owned shipping corporation (The Myanma Five Star Line) Foreign-going and coastal ships	24
(b) Other Government departments' coastal ships	23
(c) Private owned coastal ships	30
(d) Fishing vessels	81
(e) Wooden ships of primitive builds	553
(f) Other foreign owned ships registered in Myanmar	44

1.5 The Myanma Five Star Line

The Myanma Five Star Line is the state owned shipping line and is under the Ministry of Transport and Communication. The shipping line is operating the world wide trade with 11 foreign-going ships of total gross tonnage 90,000 between Europe/Yangon and Far East/Yangon as well as the coastal transporting of passengers and cargoes. There are also seven ships operating in near trade which is between the Singapore and India range, and four passenger ships of 300 passenger capacity are operating along the Myanma coast. Two refrigerated cargo ships of total gross tonnage 1000 are carrying fish and prawns from Yangon to Singapore.

1.6 Ship Construction and Repair Facilities

Myanma Dockyard, which is under the Ministry of Transport and Communication, is the construction shipyard in Myanmar. It is located in Yangon and is only capable of constructing up to 1,000 deadweight tons. The coastal ships and inland crafts are built at the Myanma Dockyard

whereas the foreign-going ships are from the foreign shipyards. As the Myanma Dockyard's main task is for new ship construction, the departments which have their own ships, such as the Department of Marine Administration, Myanma Ports Authority, etc., have to provide their own small shipyards for repair and maintenance of their ships. The repair facilities with limited range for the national ships and visiting ships are provided by the Myanma Ports Authority's shipyard.

1.7 Institution for Training of Seafarers

The Institute of Marine Technology, Yangon, is the only institute in the Union of Myanmar for training of sea-going personnel, and was established in 1972 under the auspices of the Ministry of Transport and Communication.

1.7.1 Courses Available

The following courses are available at the Institute of Marine Technology :-

(1) One year pre-sea training course for foreign-going nautical cadets,

(2) One year pre-sea training course for fishery deck cadets,

(3) One year pre-sea training course for port (coastal) deck cadets,

(4) One year pre-sea training course for inland deck cadets,

(5) One year basic training course for engineering cadets

(6) Three months basic seamanship course for ratings as:
- deck
- engine
- catering,

(7) Radar observer course,

(8) Radar simulator course,

(9) Modular courses, which include
- firefighting
- survival at sea
- survival craft
- first aid,

(10) Tanker safety course,

(11) Refresher courses for examination preparation for various grades.

1.7.2 Entry Requirements

Cadets for pre-sea training

The entry requirements for the cadets for various pre-sea training courses are :-

(i) maximum age of 21 years,

(ii) must pass at least second year university level with major subject either in Physics or Mathematics,

(iii) must pass eyesight test conducted by the Department of Marine Administration,

(iv) must pass the medical examination.

The one year pre-sea training courses are residential courses.

Basic seamanship courses

The entry requirements for the basic seamanship courses are :-

(i) maximum age of 25 years,

(ii) must pass at least middle school qualification,

(iii) must pass eyesight test conducted by the Department of Marine Administration,

(iv) must pass medical examination.

The three months basic seamanship courses are also residential courses.

Radar observer course

Candidates are required to have at least three years service in the deck department to enroll for the radar observer course. The radar observer course is an important course for deck officers. The candidate must produce his valid Radar Observer Certificate upon claiming his Certificate of Competency.

Radar simulator course

Candidates, holding at least Second Mate (Foreign-going) Certificate and Radar Observer Certificate, are eligible to attend the radar simulator course, duration of which is one week.

Tanker safety course

Six weeks is conducted for officers and ratings with previous sea-going service / experiences.

Short safety course

A two week short course is offered which includes, fire fighting, survival at sea, survival craft and first aid. It is open to all registered seamen.

Refresher courses

Six to nine months refresher courses, also known as preparation for examination courses, for Second Mate, First Mate, Master, First Class Engineer and Second Class Engineer Certificates of Competency examinations are available at the Institute of Marine Technology.

CHAPTER 2

IMPLEMENTATION OF INTERNATIONAL CONVENTIONS

2.1 The International Maritime Organization

The International Maritime Organization (IMO) is a specialized agency of the United Nations and was established as a result of the Convention adopted at the United Nations Maritime Conference held in Geneva in 1948. It is an intergovernmental body and global in membership. Only States may become full members of the Organizations. IMO operates largely through its organs and bodies composed of representatives of Member States. The principal organs are the Assembly, the Council and the four main committees namely the Maritime Safety Committee, the Legal Committee, the Marine Environmental Protection Committee and the Technical Co-operation Committee. There are ten sub-committees under the Maritime Safety Committee and the Marine Environmental Protection Committee. They are sub-committees on Stability and Load Lines and Fishing Vessels Safety, Fire Protection, Ship Design and Equipment Bulk Chemicals, Safety of Navigation, Containers and Cargoes, Radio Communication, Life Saving, Search and Rescue, the Carriage of Dangerous Goods, and Standards of Training and Watchkeeping. IMO does not set the standards or make the regulations but provides machinery to facilitate co-operation between the Member States in producing agreed regulations from proposals made by those Members. The Conventions in which these regulations are contained enter into force on dates determined by the

Contracting Governments.

The standards set in IMO's regulations, whether they are contained in treaty instruments or in recommendations, are for implementation by the States. There is no authority for IMO as an organization to implement or enforce any regulation or standard on any ship or any State. The whole basis of the "regulatory function" of the Organization is that it develops, by international co-operation, standards and regulations which are to be implemented and enforced by States, individually or collectively as appropriate.

The main purposes and functions of the Organization are:

- to provide machinery for co-operation among the Governments in the field of governmental regulations and practices relating to technical matters of all kinds affecting shipping engaged in international trade.
- to encourage the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and the prevention and control of marine pollution from ships
- to encourage the removal of discriminatory action and unnecessary restrictions affecting international shipping so as to promote the availability of shipping services to the commerce of the world without discrimination
- to provide exchange of information among the Nations on matters under consideration by the Organization
- to provide for the drafting of conventions, agreements, or other suitable instruments, and recommend these to Governments and to inter-governmental organizations, and convene such conferences as may be necessary.

2.2 IMO Conventions

In order to achieve its objectives IMO has promoted the adoption of 31 conventions and protocols, nearly all of which are now in force. Conventions and protocols are binding legal instruments, and upon entry into force their requirements must be implemented by all States which are party to it.

The list of IMO conventions and protocols is:

Safety

(1) International Convention for the Safety of Life at Sea, 1974, as amended
(2) 1978 Protocol, as amended
(3) 1988 Protocol
(4) International Convention on Load Lines, 1966
(5) 1988 Protocol
(6) International Convention on Tonnage Measurement of Ships, 1969
(7) Special Trade Passenger Ships Agreement, 1971
(8) 1973 Protocol
(9) Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended
(10) International Convention for Safe Containers, 1972, as amended
(11) Convention on the International Maritime Satellite Organization and Operation Agreement, 1976
(12) Torremolinos International Convention for the Safety of Fishing Vessels, 1977
(13) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978
(14) International Convention on Maritime Search and Rescue, 1979

Preventing Marine Pollution

(15) International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969

(16) 1973 Protocol

(17) International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, as amended

Liability and Compensation

(18) International Convention on Civil Liability for Oil Pollution Damage, 1969

(19) 1976 Protocol

(20) 1984 Protocol

(21) International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971

(22) 1976 Protocol

(23) 1984 Protocol

(24) Athens Convention Relating to the Carriage of Passengers and their Luggage by Sea, 1974

(25) 1976 Protocol

(26) Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971

(27) Convention on Limitation of Liability for Maritime Claims, 1976

Other Matters

(28) Convention on Facilitation of International Maritime Traffic, 1965, as amended

(29) Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988

(30) Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the

Continental Shelf, 1988

(31) Salvage 1989

2.3 Implementation Procedure

When the governments accept the International Conventions they agree to implement their requirements as far as their own ships are concerned. This means, in most cases, raising their standards to the levels contained in the Convention by means of the appropriate national legislation. At the same time, Contracting Parties agree that ships flying their flag can be subject to inspection and other control procedures when in ports and territorial waters of other parties. The implementation of the conventions will require planned effort by the governments, industry and institutions. The following is an outline of measures to be taken, particularly in the developing countries, to implement the conventions which cover construction, equipment and operation of the ships.

(1) Government and industry should:

(a) understand the technical and administrative implications of the provisions of the conventions.

(2) Industry (Shipbuilders, shipowners and manufacturers) should:

(a) develop and manufacture equipment complying with the convention requirements and related guide lines and specifications developed by the IMO;

(b) arrange for construction or conversion of ships and installation of equipment to comply with the convention requirements;

(c) develop procedures for operation of ships to meet the convention requirements;

(d) train personnel on board.

(3) Governments should:

(a) take necessary legislative procedures to ratify and implement the Convention;

(b) establish systems of surveys and certification of ships, including authorization of classification societies if so desired;

(c) establish administrative structure and arrangements, such as the maintenance of records for ships flying their flags, supervision of classification work;

(d) develop systems and procedures for the enforcement of the conventions, including:-

- inspection of ships in ports and terminals (non-convention ships should be inspected in such a way that no more favourable treatment of such ships is given)
- detection of unlawful discharges and establishment of penalties to be imposed
- investigation of marine casualties
- preparation and submission to the International Maritime Organization of reports and other information as called by the relevant convention.

Conventions required to be implemented are to be dealt with as follows:-

Phase One

(a) Ratification or accession

(b) Prepare National Legislation (Primary and subsidiary)

(c) Documentation

(d) Prepare executive orders and instructions to officials concerned

(e) Develop adequate and appropriate Maritime Administration infrastructure.

Phase Two

Implementation of National legislation through the exercising of appropriate functions by the officials of Administration.

Phase Three

Certification of ships and seafarers and issue of clearance to proceed to sea.

2.4 Implementation of STCW Convention

Contracting Governments should take all practicable steps to ensure that the education and training of masters, officers and seamen in the use of aids of navigation, of life-saving appliances and authorized devices designed for prevention, detection and extinction of fires or for preventing or alleviating casualties at sea is sufficiently comprehensive. These works should be done in co-operation with the other contracting governments if necessary. By refresher courses or by other appropriate means, such education and training should be kept up to date and in step with modern technical developments in this field. The stage of training and certification, when the detailed guidance should be included in training programmes or examination, should be in accordance with the minimum requirements of the STCW 1978 and other relevant international conventions and recommendations.

In implementing STCW Convention the following training courses for seafarers are needed. The training courses have to meet the relevant requirements of the STCW Convention.

2.4.1 Ratings

(i) **Deck Department**

(a) Pre-sea training for the new entrant. This needs to include "personal survival techniques".

(b) Subsequent refresher training, for ratings with appropriate sea service, so as to meet the mandatory minimum requirements for a rating, forming part of a navigational work, as specified in the STCW Convention. It is most desirable that such training leads to the "Efficient Deck Hand Certificates" or its equivalent, and the "Proficiency in Survival Craft Certificate".

(c) Fire-fighting training.

(d) Training in basic first aid.

(ii) **Engine-room Department**

(a) Pre-sea training for the new entrant. This needs to include "Personnel Survival Techniques".

(b) Subsequent refresher training, for ratings with appropriate sea service, so as to meet the mandatory minimum requirements for a rating, forming part of an engine-room watch, as specified in the STCW Convention. It is most desirable that such training leads to a suitable certificate.

(c) Fire-fighting training.

(d) Training in basic first aid.

2.4.2 Officers

(i) **Deck Department**

(a) Pre-sea training for the new entrant as Deck (Nautical) Cadet.

(b) Training on board ships at sea, as Deck Cadet.

(c) Post-sea training leading to the first Certificate of Competency as a Watchkeeping Officer.

(d) Subsequent post-sea training leading to all higher Certificates of Competency, including as Master.

(ii) Engine-room Department

(a) Pre-sea training for the new entrant as Engineer Cadet / Apprentice.

(b) Training on board ships at sea, as junior engineer.

(c) Post-sea training leading to the first Certificate of Competency as a Watchkeeping Engineer.

(d) Subsequent post-sea training leading to all higher Certificates of Competency, including as Chief Engineer.

In addition there is the need for the training of Radio Officers. Matters pertaining to the training of such personnel are:

(a) primarily governed by the requirements of the Radio Regulations of the International Telecommunications Union, and

(b) dealt with by the Ministry responsible for all forms of telecommunications. The Maritime Safety Administration needs to liaise with the Ministry so as to ensure the availability of such personnel for ships and that they also meet the additional requirements of the STCW Convention.

2.4.3 Additional Special Courses

(a) Training of officers and ratings of oil tankers.

(b) Training of officers and ratings of chemical tankers.

(c) Training of officers and ratings of liquefied gas tankers.

(d) Radar Simulator Training for Deck officers.

2.5 IMO Conventions and the Union of Myanmar

Myanmar has ratified the following IMO Conventions:

(1) International Convention for the Safety of Life at Sea 1974, Protocol 1978, Amendments 1981 and 1983.

(2) Convention on the International Regulations for Preventing Collision at Sea, 1972.

(3) International Convention for the Prevention of Pollution from Ships, 1973/1978.

(4) International Convention on Load Lines, 1966.

(5) International Convention on Tonnage Measurement of Ships, 1969.

(6) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.

In implementing the STCW Convention the following courses are now conducted in the Union of Myanmar:

(i) Basic seamen courses (Deck and Engine).

(ii) Efficients hands courses (Deck and Engine).

(iii) Special courses for basic first aid, fire-fighting, personnel survival and survival craft.

(iv) Oil and chemical tanker safety courses (Officers and ratings).

(v) Radar simulator course.

With the significant technological changes experienced by the shipping industry in recent years, the above courses are to be modified from time to time, to keep abreast of the international standards.

CHAPTER 3

SOURCES OF ENTRY INTO THE MARINE ENGINEERING FIELD IN MYANMAR

Maritime training systems differ from one country to another among the maritime nations. The old British system of training is mostly adopted by the commonwealth nations. The Continental system is mostly followed by European countries. The American system of training has its own merits. Myanmar follows very closely the British system of training because it is familiar to the country.

Training programme for the Merchant Naval personnel has been carried out in the Union of Myanmar since 1963 with the joint effort of the qualified persons who had their earlier training abroad.

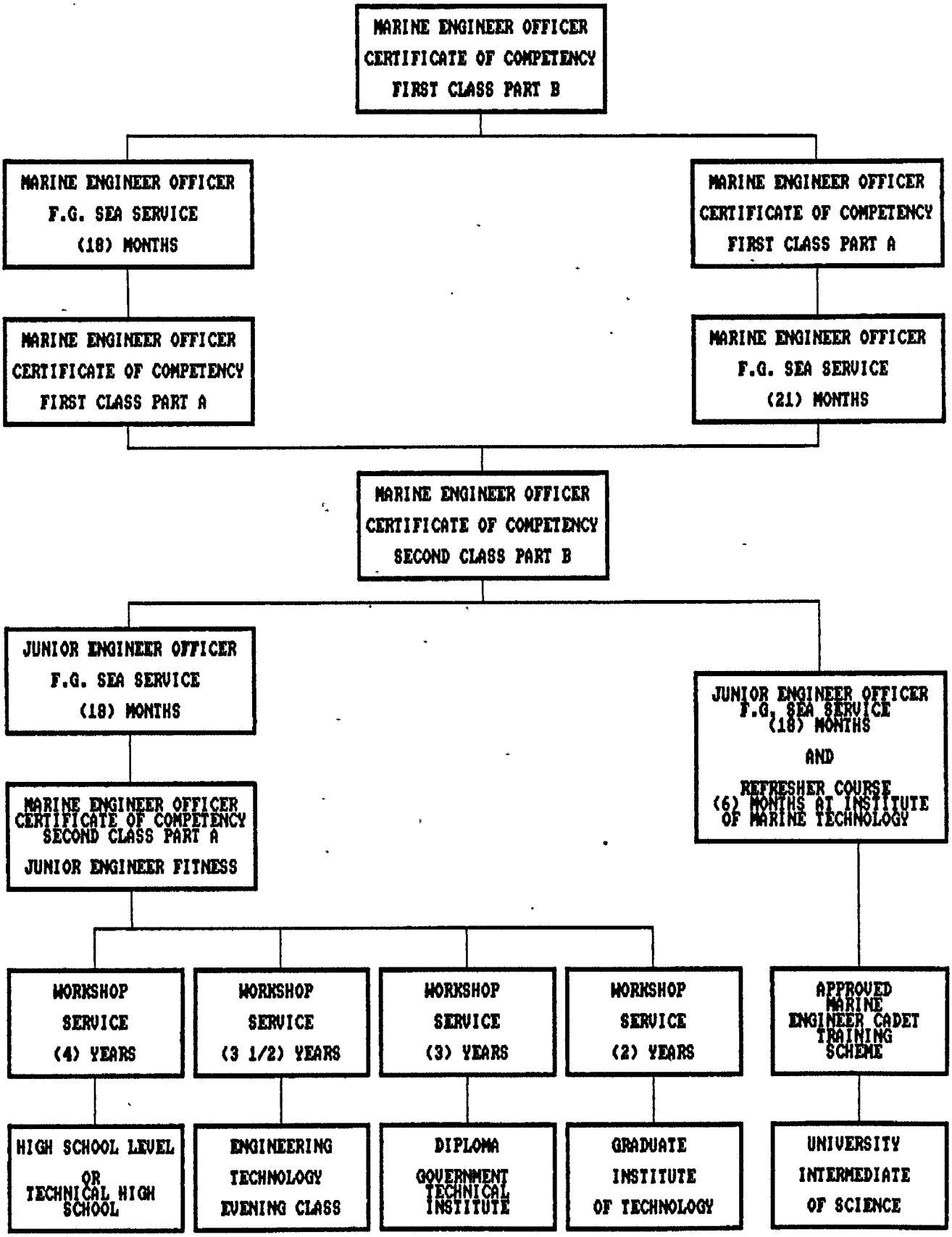
The entry sources to become a marine engineer in the Union of Myanmar can be generally divided into three main sources (see Figure 3).

3.1 The Traditional Training Scheme

The traditional method of entry is as a junior engineer after having completed an apprenticeship in a marine or other engineering workshop approved by the Government. The dockyards approved by the Government for qualified workshop training are the Department of Marine Administration Dockyards, Yangon and Mandalay, Myanma Dockyard, Yangon, Myanma Ports Authority Dockyard, Yangon,

Figure (3)

MARINE ENGINEER OFFICER TRAINING AND CERTIFICATION UNION OF MYANMAR



Source: Bibliography. 15

and Inland Water Transport Board Dockyard, Yangon.
Entry requirements are:-
(i) minimum age of 16 years, and
(ii) must have at least high school level qualification.

During the apprenticeship, which normally lasts at least four years, the apprentice engineers and those who have successfully completed the technical courses in mechanical engineering supplemented by evening classes, leading to Engineering Certificate or Diploma, are entitled to have an exemption from parts of the examinations for Second Class Engineer certificate of competency. Academic and professional subjects are taught and off-the-job workshop training is performed in these evening classes. An apprentice engineer must have performed satisfactory service for not less than 4 years on works suitable for the training of a marine engineer in the manufacture or maintenance of machinery. Not less than nine months of this workshop service required should have been devoted to fitting, erecting or repairing machinery of a suitable size or description e.g., work on marine propelling machinery, substantial auxiliary machinery of a type fitted in ships. The remaining period may have been spent on work of this nature or on other suitable work, subject to a time allowance for each type of work, examples of which are specified below.

Metal turning.....Full time up to a maximum of two years.
Brass finishing.....Full time up to a maximum of one year.
Boiler making or repairing....Full time up to a maximum of one year.

Pattern making, planning slotting.....Full time up to a maximum of one year.

Shaping and milling.....Full time up to a maximum of one year.

Tools room.....Full time up to a maximum of one year.

Approved scheme of training in the use of hand and small machine tools.....Full time up to a maximum of one year.

Smith work.....Full time up to a maximum of six months.

Welding.....Full time up to a maximum of six months.

Work in drawing office.....Full time up to a maximum of one year.

Electrical work.....Full time up to a maximum of 18 months.

Instrument and distance control, gear, fitting.....Full time up to a maximum of 6 months.

To become a Junior Engineer in Myanmar it is required not only to pass Part A of the examination for the Second Class Engineer certificate but also the examination for Junior Engineer Fitness. All the examinations above are conducted by the Department of Marine Administration. Then they have to perform at least 18 months of qualified sea service on board the foreign going ships to get eligibility to attempt the Second Class Engineer certificate of competency.

Preparatory courses ashore, of from six to nine months duration depending on the class of certificate, are

available at the Institute of Marine Technology, Yangon. Those who have completed satisfactory workshop or sea services are eligible to attend these courses.

3.2 The Engineer Cadet Training Scheme

This scheme is the effective method of providing comprehensive and systematic training specially for sea-going engineers. All requirements of a marine engineer officer are incorporated in the academic education and professional training syllabuses. The scheme has served the industry relatively well, and through improved selection and systematic marine training, now produces better officers in general than the traditional scheme. The entry requirements are:-

(i) maximum age of 21 years,

(ii) must pass at least second year university level with major subject either in Physics or Mathematics, or

(iii) must pass at least second year level of Yangon Institute of Technology (Engineering Degree Course), or

(iv) must pass the final examination of Government Technical Institute (Engineering Diploma Three years course),or

(v) other equivalents of the above mentioned requirements.

The Engineering Cadet Training Scheme is conducted in five phases, normally in the following order.

Summary of training programme

		Years	Months
Phase I	:Basic training	1	-
Phase II	:Practical training in workshops	2	-
Phase III	:On board practical training	1	-

Phase IV	:Qualified sea service	1	6
Phase V	:Preparatory course for Second Class Engineer Examination	-	6
	Total	6	-

3.2.1 Phase I: Basic Training

This is a one year course for full time study of engineering for Part A of the Second Class Engineer Certificate including basic craft training in hand and machine tools.

Theoretical Studies

	Subjects	Hours
(i)	Applied Mechanics	240
(ii)	Engineering Drawing	267
(iii)	Mathematics	120
(iv)	Heat and Heat Engines	240
(v)	Workshop Technology	54
(vi)	Engineering Knowledge	66
(vii)	Common Course with other cadet courses*	106
	Total	1093

* Incorporating Fire-fighting, Survival at Sea, Survival Craft and First Aid Courses.

Practical Training

	Subjects	Hours
(i)	Boat sailing	58
(ii)	Swimming, Excursions	54
(iii)	Sea cruising	56
	Total	168

Total Theoretical Studies	1093
Total Practical Training	168
Total for Basic Training Period	1261

Special evening classes incorporated in the basic training period for off-the-job workshop training and English language course.

3.2.2 Phase II: Practical Training in Workshops

Twenty four months vocational practical training in a suitable marine or other approved workshop. This includes engineering knowledge classes, conducted by the Institute of Technology, on weekends.

	Shops	Hours
(i)	Fitting shop	960
(ii)	Machine shop	960
(iii)	Welding shop	960
(iv)	Electrical shop	960
	Total	3840

All cadets are required to keep their record books, provided by the training institute, throughout their training period.

The objective of this book is to provide a comprehensive record of the progress of a cadet's training during the different phases of the training programme. The safety and maintenance of this record book is the responsibility of the cadet. All personal information and particulars must be filled in by the cadet and it must be ensured that officers responsible for the training and supervision attach other remarks and signatures immediately after each

phase of the training or end of every task. Course officers, Dockyard Engineers and Chief Engineer Officers are to inspect the record book at regular intervals of not more than one month and on joining and leaving the respective establishment and vessels.

3.2.3 Phase III: On Board Practical Training

Every cadet must perform 12 months service at sea as a Cadet Engineer. During this period the cadets are trained to operate, maintain and repair the marine machineries. They are also assigned to keep regular watches in main propulsion engines and auxiliary boilers simultaneously as assistant to the watchkeeping engineers while the ship is at sea.

3.2.4 Phase IV: Qualified Sea Service

The cadets of this training scheme are exempted from Part A of the examination of Second Class Engineer certificate of competency. 18 months of qualified sea service must be performed on board the foreign-going motor vessels of not less than 373 brake horse power (this is the examination regulation minimum requirement and normally the engineers performed their sea service on board the ships of the National Shipping Line with engine powers of more than 5000 brake horse power) as an engineer at sea on regular watch, i.e., on watch for not less than eight out of each twenty-four hours' service claimed. Service in ships where a watchkeeping engineer is, as part of his regular duties, required to do work not usually performed by a watchkeeping engineer in the Merchant Navy cannot be accepted as qualifying.

3.2.5 Phase V: Preparatory Course for Second Class Engineer Certificate of Competency

A preparatory course of 6 months duration, conducted by the Institute of Marine Technology, is a compulsory course in the Engineer Cadet Training scheme.

	Subjects	Hours
(i)	General Engineering Knowledge	180
(ii)	Motor Engineering Knowledge	180
(iii)	Electrotechnology	180
(iv)	Naval Architecture	180
	Total	720

3.3 The Graduate Training Scheme

This is one of the entry routes into the marine engineering field for the graduates who have completed a full-time course of study of a university degree in Engineering. This scheme covers a longer period of initial training and requires at least a total of eight years to become a watchkeeping engineer officer, six years for degree, and not less than 2 years in workshops on work suitable for the training of a marine engineer. Not less than six consecutive months of this period should have been devoted to fitting, erecting or repairing machinery of a suitable size. The remaining 18 month period may have been spent on other suitable work, subject to a time allowance for each type of work, examples of which are specified in paragraph 3.1 of this chapter. The scheme provides a high academic qualification at the intake level, which can be an advantage in the later part of the candidate's career.

Summary of the training scheme

		Years	Months
(i)	Full time course of study at university including off-the-job practical training in university workshop	6	-
(ii)	Practical on-the-job training in workshops	2	-
(iii)	Qualified sea service	1	6
	Total	9	6

Candidates who have obtained a Mechanical Engineering Degree recognized by the Government are exempted from Part A of the examinations for the First and Second Class Engineer certificate of competency, except the Engineering Drawing subject in Second Class. After having received an exemption from Part A of the Second Class examination they are required to pass the Junior Engineer Fitness examination, conducted by the Department of Marine Administration, to become a junior engineer. A reduction of up to three months' sea service is granted to them for both certificates of competency as they have obtained exemption from Part A. They are required to perform only 18 months' sea service for both certificates.

3.4 Remission

All men, irrespective of whether they have entered after a traditional scheme or have served a cadetship, must normally perform at least 21 months' sea service as a watchkeeping engineer before they may attempt the examination for the Second Class certificate of competency. A candidate for the First Class certificate must also normally have at least 21 months' sea service

while holding a Second Class certificate. Candidates for both certificates, who have passed Part A of the examination or who obtained exemption from that part may be granted a remission of qualifying sea service not exceeding three months as follows:-

(i) those who pass or gain exemption before starting qualifying sea service three months.

(ii) those who pass or gain exemption before completing 9 months' qualifying sea service two months.

(iii) those who pass or gain exemption before completing 15 months' qualifying sea service one month.

3.5 STCW 78 Requirements

Entry requirements are:-

(i) minimum age of 18 years

(ii) must satisfy the Administration as to medical fitness, including eyesight and hearing

(iii) must have adequate basic education.

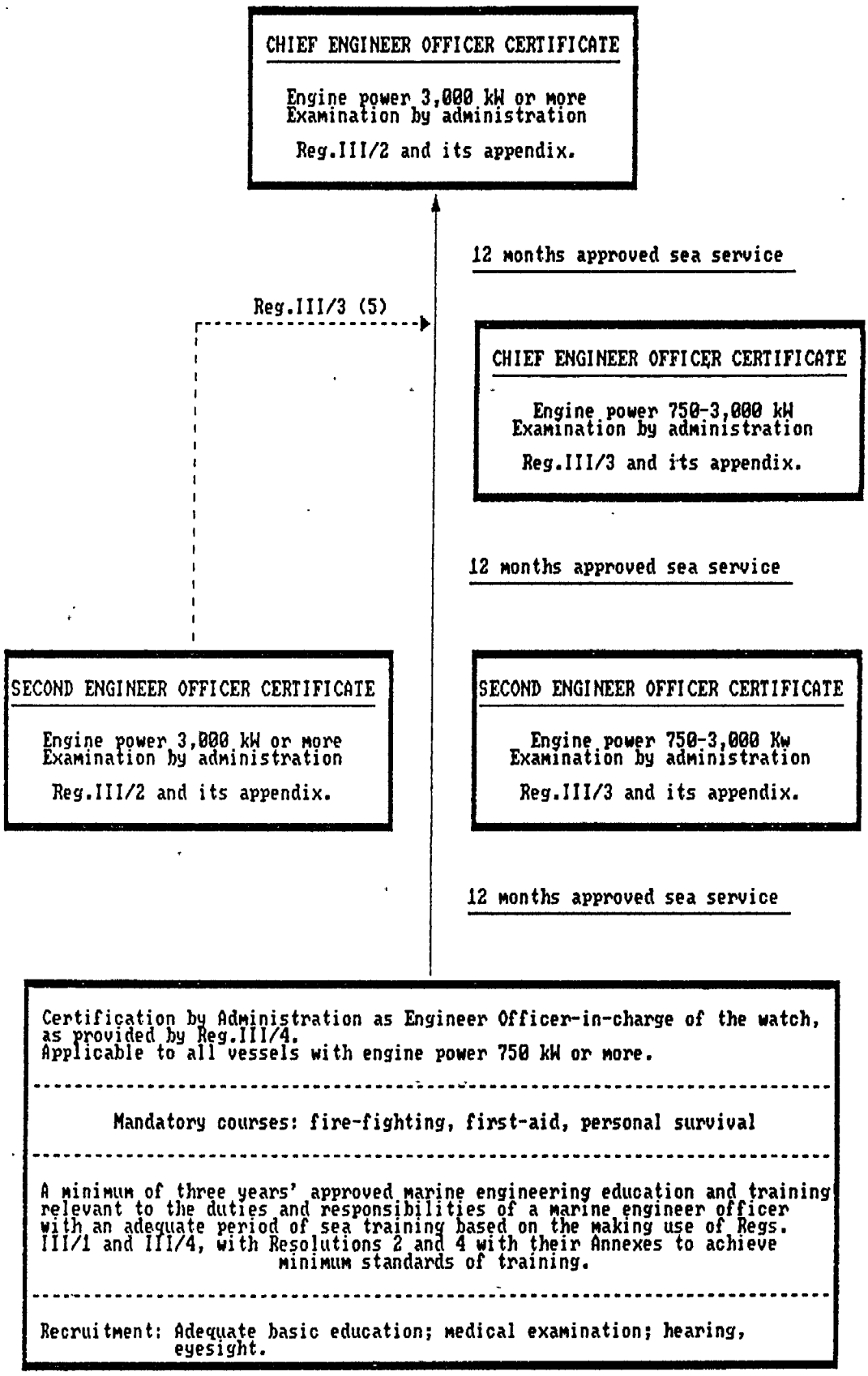
3.5.1 Watchkeeping Engineer Officers

For certification of watchkeeping engineer officer on board vessels with main engine of 750 kW propulsion power or more, an adequate sea service which may have been included within the period of three years approved education or training, relevant to the duties of a marine engineer must be performed. Service requirements may be varied for vessels with less than 3000 kW propulsion power (see Figure 4).

3.5.2 Second Engineer Officers

For certification of Second Engineer Officer on board vessels with engine power 750 kW to 3000 kW, or more, approved sea service of not less than 12 months as assistant engineer officer or engineer officer is

MARINE ENGINEER OFFICER TRAINING AND CERTIFICATION IN TERMS OF THE IMO STCW 1978 CONVENTION



Source: STCW 1978

required.

3.5.3 Chief Engineer Officers

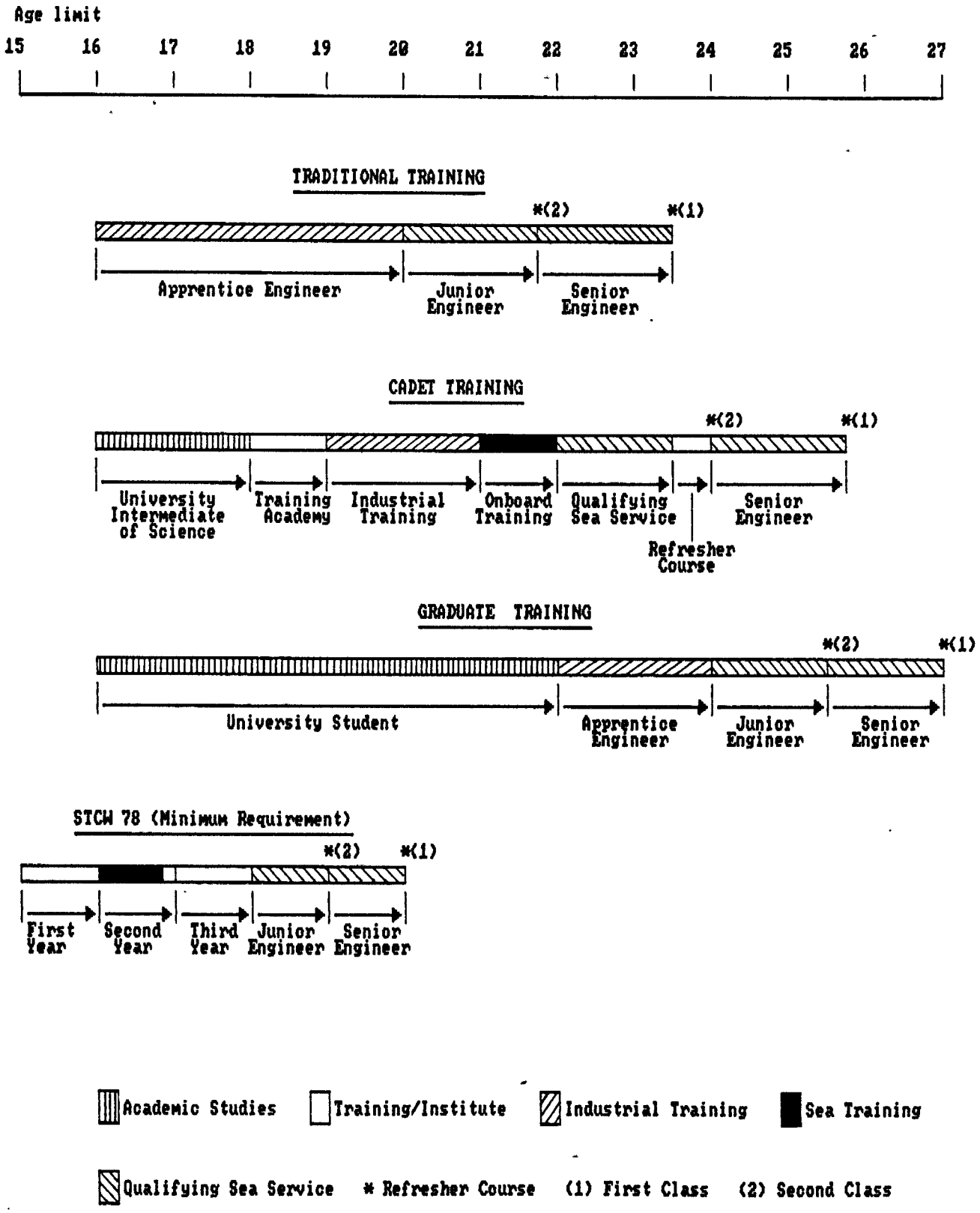
For certification of Chief Engineer Officer of ships powered by main engine of 3000 kW propulsion power or more, approved sea service of 36 months of which not less than 12 months shall be served in a position of responsibility while qualified to serve as Second Engineer Officer.

For certification of Chief Engineer Officer of ships powered by main engine of between 750 kW and 3000 kW propulsion power, approved sea service of 24 months of which not less than 12 months shall be served while qualified to serve as Second Engineer Officer.

The present standard of the marine engineering training system in the Union of Myanmar can be seen as higher than the requirements and therefore acceptable in International shipping when compared with STCW 78 minimum requirements (see Figure 5). But the marine engineers trained and certified by this standard have to work on board the vessels of the National Shipping Line and other foreign shipping companies. They are the foreign exchange earners of the country. Nowadays most of the shipping companies own the ships fitted with machineries and equipment of high technology. Also the National Shipping Line is now acquiring two semi-automated and four fully automated ships. The present generation ocean going merchant ship is likely to have crew numbers as low as 18, and experimental crewing arrangements indicate the reality of substantial further reductions down to 11 in the near future. To be competent to get employment in foreign shipping companies, Myanma marine engineers must acquire

Figure (5)

COMPARISON OF VARIOUS TRAINING SCHEMES



Source: STCW 1978 and Bibliography 11

additional knowledge about these modern machineries and equipment as the shipowners are only interested in employing more highly trained ones. So instead of being content with the present standard, Myanmar should review her training system in regular periods in view of the rapid advancement of maritime technology and international developments.

CHAPTER 4

PRESENT SYLLABI IN COMPARISON WITH STCW 78 CONVENTION

The STCW Convention was adopted by the member countries of IMO at an international conference in London in 1978. At that time the majority of the developed maritime countries possessed well established education and training systems for their seafarers which could meet the majority of the Convention requirements. These countries therefore needed to make only a few adjustments to their maritime education and training systems between the adoption of the Convention and its coming into force. The Convention came into force in April 1983. The developing countries with little formal maritime infrastructure have found many problems to overcome for the adoption of the STCW Convention. As ship owning and ship operating countries, they were to meet the requirements of this International Convention. The main requirement for these countries was possession of an effective national maritime legislation which would control a system for the examination and certification of seafarers before the issue of certificates of competency. The STCW Convention lays down minimum requirements for training, qualifications and seagoing service for masters, deck officers, engineer officers, radio officers and certain categories of ratings which must be met before a Government may issue certificates of competency under the Convention. The Convention also lays down principles of deck and engine watchkeeping. Several countries, including developing

countries, modified their training and certification rules to conform to the minimum global principles embodied in the Convention. The benefit of this Convention to developing countries in particular has been that they have a set of guidelines on which to base their development of maritime education and training.

Myanmar has its own national maritime legislation, which is known as Burma Merchant Shipping Act (see Appendix G). It contains rules relating to the examinations for deck and engineer officers for the issuance of the certificates of competency. In exercise of the power conferred by section 21 of the Burma Merchant Shipping Act, the Ministry of Transport and Communications has made and issued the rules relating to the syllabi for the examinations of First and Second Class Engineers' certificates of competency.

The syllabi for First and Second Class Engineers' Certificates of Competency examinations, which are the appendixes to these rules and are presently used in the Union of Myanmar, are given in Appendix (A) of this study paper for reference purpose.

The STCW 78 Convention's mandatory minimum requirements are contained in Annex-Regulations and divided into six chapters. Chapter III is concerned with the Engine Department and the Appendix to Regulation III/2 is relevant to this comparison statement.

The syllabi are divided into two groups: the theoretical knowledge subjects and the practical knowledge subjects. The objective of the theoretical subjects is that the student will acquire knowledge and understanding of the

fundamental principles and statements, and the use of simple numerical calculations. Practical subjects are aimed at the development of professional competency. They are designed to acquire skill and knowledge in safe operation of machinery, the inspections and measurements that must be made to determine wear and deterioration of machinery components, and planned maintenance.

STCW	Myanmar
Theoretical Knowledge Subjects	
1. Thermodynamics and heat transmission.	Fully covered the requirements. The form of the syllabus needs clarification and more detail. For example: Heat Transfer The expected outcome is that the student: 1.1 Understands that heat transfer can take place in three modes. 1.2 Identifies these modes as: 1.2.1 conduction 1.2.2 convection 1.2.3 radiation 1.3 Defines specific heat as the heat transfer, per unit mass, per unit of temperature change, for any given body.

2. Mechanics and hydromechnics.	Almost covered. Only required to add the following: - Effect of 'sounding', 'air release' or other 'stand pipes' when containing liquid - The hydraulic lifting machine
3. Operational principles of ship's power installations (diesel, steam and gas turbine) and refrigeration.	Totally covered in Heat and Heat Engines syllabus. Though already contained in the syllabus, steam and gas turbines portion required to be emphasized.
4. Physical and chemical properties of fuel and lubricants.	Fully covered in Engineering Knowledge's item (q). Engineering Knowledge is a practical subject in Myanma syllabus.
5. Technology of materials.	Fully covered in Engineering Knowledge's item (a). Though it is not shown in the present syllabus clearly, the metallurgy subject is taught, as a part of Workshop technology, starting from iron ores to the production of different types of steel. Also ferrous and non-ferrous metals, ferrous and non-

	ferrous alloys, destructive and non-destructive tests on materials are taught. These topics need to be added to the syllabus.
6. Chemistry and physics of fire and extinguishing agents.	Fully covered in Engineering Knowledge's item (i).
7. Marine electrotechnology, electronics and electrical equipment.	Covered except the electronics portion. Though it is taught in both classes, as per First Class electrotechnology syllabus, required to expand the following: - Transistor theory including base, emitter, collector and bias. - Transistor used as amplifier. - Amplifier function. - How the devices in an electronic circuit can be represented by blocks with specified inputs and outputs. - What is meant by logic analysis and a truth table. - Gates; AND, OR, NOT and their symbols. - Drawing a logic diagram using the symbols.

	- The concept of an integrated circuit. - Large Scale Integration and its use for micro processor. Electrotechnology is a practical knowledge subject in Myanmar.
8. Fundamentals of automation, instrumentation, and control system.	This subject is not shown in the syllabi. It is now taught as part of the engineering knowledge subject in both classes and the candidates are asked some automation questions in their examinations in both written and oral. Required to express and develop this subject to meet the present standard.
9. Naval Architecture and Ship Construction, including damage control.	Fully covered. Also Naval Architecture is a practical knowledge subject in Myanma syllabus.
Practical Knowledge Subjects	
10.Operation and maintenance of: (a) marine diesel engine (b) marine steam propulsion plant (c) marine gas turbine.	Fully covered in Engineering Knowledge's items (e), (k), (q), (s), (t), and (u).

11.Operation and maintenance of auxiliary machinery, including pumping and piping systems, auxiliary boiler plant and steering gear system.	Fully covered in Engineering Knowledge's items (f), (g), (k), (m), (o) and (w).
12.Operation, testing and maintenance of electrical and control equipment.	Electrical portion fully covered. Required to develop the control equipment portion.
13.Operation and maintenance of cargo handling equipment and deck machinery.	Fully covered in Engineering Knowledge's item (g). It is required to express it specifically in the syllabi.
14.Detection of machinery malfunction, location of faults and action to prevent damage.	Fully covered in Engineering Knowledge's items (h), (v) and (x).
15.Organization of safe maintenance and repair procedure.	Fully covered in Engineering Knowledge's items (w) and (x)
16.Methods of, and aids for, fire prevention,detection and extinction.	Fully covered in Engineering Knowledge's item (i).
17.Methods and aids to prevent pollution of the environment by ships.	Not shown in the syllabi, but taught in accordance with the IMO's MARPOL regulations. Required to express it in the

	syllabi.
18.Regulations to be observed to prevent pollution of the marine environment.	Same as item 17.
19.Effects of marine pollution on the environment.	Same as item 17.
20.First aid related to injuries which might be expected in machinery spaces and use of first aid equipment.	Not shown in the syllabi, but this subject is taught as a compulsory special course to all non-certified personnel.
21.Function and use of life saving appliances.	Required to be developed.
22.Methods of damage control.	Fully covered.
23.Safe working practices.	Fully covered.
24.International maritime law embodied in international agreements and conventions. Responsibilities of the engine department particularly those concerning safety and the protection of the marine environment.	Required to be developed.

25.	Personnel management, organization and training aboard ships.	Required to be developed.

Syllabi presently used for examination and certification of seafarers in Myanmar are generally found to be acceptable in international standards with regard to the requirements laid down by the STCW 78 Convention. But we must take all necessary steps to give full and complete effect to the Convention and its annex in order to ensure that seafarers are qualified and fit for their duties from the point of view of safety of life and property at sea and the protection of the marine environment. Marine technologies are developing at a time when the growth of knowledge is expanding surprisingly. This growth has directly affected seafaring and training for which maritime institutions are responsible. For all developments in equipment and technology, proper training is required for those responsible for operating such equipment to carry out their duties in the correct order and manner. Syllabus and training courses available to the seafarers must be monitored continuously to ensure that they are able to meet the demands placed upon them and to understand and operate successfully the equipment at their disposal. Their training should reflect the increasing importance of such subjects as pollution control, shipboard operations, shipboard safety practices, knowledge of statistical methods and onboard management. Training courses must therefore be designed to enable trainees to cope with the changes in technology which they will experience during their careers.

CHAPTER 5

EXAMINATION SYSTEM AND ISSUES OF CERTIFICATES OF COMPETENCY / SERVICE TO MARINE OFFICERS

Although the Burma Merchant Shipping Act contained provisions on the examination and issue of Certificate of Competency for deck and engineer officers long before the birth of the IMO, which came into being in 1948, all Myanma seafarers had to obtain their maritime training and education abroad, mostly in the United Kingdom and India. After independence in 1948 and with the acquisition of national flag ships in the 1950s, some obtained their training on board them, although examinations were still taken abroad as there were no examination facilities. During the period between 1968 and 1974 Myanmar introduced her own Certificate of Competency Examination Rules and today the Department of Marine Administration conducts regular examinations. The examination rules prescribe in detail requirements including physical fitness, minimum age, workshop training, approved type of vessel and minimum period of sea service and examination syllabus for each grade.

5.1 Qualifications Required for Engineering Examinations

5.1.1 First Class Engineer

(i) Candidate must hold a Second Class Engineer Certificate.

(ii) Candidate must have completed the following period of sea service.

(a) For a Steam Certificate, 21 months, of which at least nine months must have been spent on the boilers and main propelling machinery of a steam ship.
This period of at least nine months must have included at least six months service on the boilers and six months service on the main propelling machinery, but the service on the boilers and on the main propelling machinery may have been simultaneous. The remaining twelve months (or balance of twelve months) may have been spent on boilers of a steam ship, or on the main propelling machinery of a steam or motor ship, or on suitable auxiliaries of a steam or motor ship.

(b) For a Motor Certificate, 21 months, of which at least six months must have been spent on the main propelling machinery of a motor ship.
The remaining 15 months (or balance of 15 months) may have been spent on the main propelling machinery of a steam or motor ship or on suitable auxiliaries of a steam or motor ship, or to the extent of not more than six months on the boilers of a steam ship.

(c) For a combined Steam and Motor Certificate, 24 months, of which at least:-
Nine months must have been spent on the boilers and main propelling machinery of a steam ship.
This period must have included at least

six months service on the boilers and six months service on the main propelling machinery, but the service on the boilers and main propelling machinery may have been simultaneous;
and six months must have been spent on the main propelling machinery of a motor ship. The remaining nine months (or balance of nine months) may have been spent on the boilers of a steam ship or on the main propelling machinery of a steam or motor ship or on suitable auxiliaries of a steam or motor ship.

(iii) Service required must have been performed in foreign-going steam ships of not less than 99 nominal horse-power and/or motor ships of not less than 560 brake horse-power, as an engineer at sea on regular watch, i.e., on watch for not less than eight out of 24 hours service claimed. This service should have been performed as senior engineer in charge of entire watch. Day work is not accepted.

5.1.2 Second Class Engineer

(i) Candidate must be not less than 21 years of age.

(ii) (a) Except as provided for in (ii)(b) and (ii)(c), candidate must have performed satisfactory service for not less than four years as apprentice engineer on works suitable for the training of a marine engineer in the manufacture or maintenance of machinery.

(b) Candidate who has satisfactorily completed

a full-time course of study, at a Technical College or University, of at least the standard of a university degree in Engineering will be required to serve for not less than 24 months in workshops on work suitable for training of a marine engineer. Not less than six consecutive months of this period should have been devoted to fitting, erecting or repairing machinery of a suitable size.

(c) Candidate of Mercantile Marine Engineering Training Scheme usually follows a four year course consisting of (a) one year at an approved technical school studying an approved engineering course, (b) two years' practical training at approved workshops with additional evening studies, and (c) one year service at sea as an engineering cadet.

(iii) Candidate for a Second Class Certificate of Competency must, in addition to the above requirements, have completed the following period of sea services.
(Same as paragraphs (ii)(a) to (ii)(c) of First Class Engineer)

(iv) Service required must have been performed in foreign-going steam ships of not less than 66 nominal horse-power and/or motor ships of not less than 373 brake horse-power, as an engineer at sea on regular watch.

5.2 Subjects for Examinations

5.2.1 First Class Engineer

Part "A"

(i)	Applied mechanics	3 hours
(ii)	Heat and heat engines	3 hours
(iii)	Mathematics	3 hours

Part "B"

(i)	Electrotechnology	3 hours
(ii)	Elementary Naval Architecture	3 hours
(iii)	Engineering knowledge(two papers each of three hours)*	
(iv)	Oral	

* In the examination for a combined Steam and Motor Certificate a third three hour paper in Engineering Knowledge is set.

5.2.2 Second Class Engineer

Part "A"

(i)	Applied mechanics	3 hours
(ii)	Heat and heat engines	3 hours
(iii)	Mathematics	3 hours
(iv)	Drawing	6 hours

Part "B"

(i)	Electrotechnology	3 hours
(ii)	Elementary Naval Architecture	3 hours
(iii)	Engineering knowledge(two papers each of three hours and a third paper of three hours is also set for Combined Steam and Motor candidate).	
(iv)	Oral	

5.3 Issue of Certificates

The certificates of competency are issued under section (14) of the Burma Merchant Shipping Act and the certificates of service to naval officers are issued under section (17). The extract of the Burma Merchant Shipping Act relating to the issue of the certificates of competency and service is quoted as:-

14. (1) Certificates of competency shall be granted in accordance with this Act for each of the following grades, namely:-

Master of foreign-going ships
First Mate of foreign-going ships
Second Mate of foreign-going ships
Master of home-trade ships
Mate of home-trade ships
First Class Engineer
Second Class Engineer
Engine Driver

(2) A certificate of competency for a foreign-going ship shall be deemed to be a higher grade than the corresponding certificate for a home-trade ship, and shall entitle the lawful holder thereof to go to sea in the corresponding grade in such last mentioned ship; but no certificate for a home-trade shall entitle the holder to go to sea as a master or mate of a foreign-going ship.

17.(1) A person who has attained the rank of lieutenant in the Myanma Navy shall be entitled to a certificate of service as the master of a foreign-going ship without examination.

(2) A person who has attained the rank of engineer or assistant engineer in the Myanma Navy shall be entitled

without examination, if an engineer, to a certificate of service as first class engineer and if an assistant engineer, to a certificate of service as second engineer.

5.4 Present-day Examination and Certification Systems

One of the means by which a Government can support maritime education within a country is through the provision of a full Government-run maritime education and certification service. At the end of any effective training programme candidates are required to be examined in order to assess their competency before they are issued with appropriate certificates. Appropriate methods of assessing competence are crucial to the whole training scheme. In some countries a formal training programme does not have to be followed by examination. After the completion of a course the candidates are only required to fulfill the requisite amount of sea-going service to be awarded each particular class of certificate.

Many countries have examination and certification systems based on the British system. Union of Myanmar is one such country and the syllabi of examination draws on this system. It is a system wherein the examination syllabi have been directly related to each grade of certificate. The teaching has been geared directly to the separate examination syllabi.

The examination is separated into two parts, the fundamental knowledge or theoretical subjects, and practical knowledge subjects. The whole examination, including orals, is conducted by the Department of Marine Administration with preparatory courses being provided by the training institute. This examination system has produced well qualified deck and engineering officers for

many years. This system consists of an examination of the candidate's breadth and depth of knowledge in a series of written papers, which largely assess his grasp of facts, methods of calculation and knowledge of correct procedures. It also consists of an examination of a candidate's 'competency' to perform as a safe and efficient ship's officer. This is achieved by means of oral examinations before a number of examiners who have to be satisfied, from the answers provided and other factors, that the candidate is fit to hold the certificate for which he is being examined.

Through formal written examinations, candidates can be tested on their ability to communicate effectively through the written word. Also they have to explain how procedures should be followed and rules for efficient operations observed. The development of the STCW 78 Convention brought the marine administrations from different countries together to achieve a common standard. It opened up minds to different ways of achieving the objectives.

Based upon the STCW Convention's minimum requirements most of the countries draw two sets of syllabus for three levels of certificates, one for Watchkeeping officers and another for Second and First Class officers.

In some countries the integrated system of examination and certification is used. In this system there are three major requirements for issuance of a certificate of competency, which are Knowledge, Fitness and Experience. To fulfill the knowledge requirement in the long term, costly courses of study are required. This requirement concerns the educational establishments. Knowledge

requirements can be subdivided into

(i) Fundamental knowledge- which can be acquired within an educational establishment and supplemented by limited periods of industrial experience capable of being fitted into a viable education program; and

(ii) Operational knowledge and associated Skills- which can only be acquired through substantial periods of industry experience.

The fundamental knowledge comprises all the syllabi for the written examinations at the watchkeeper and Class I certificate levels, together with the limited experience and skills required by a junior watchkeeper. It is incorporated in a cohesive program of education and training approved by the marine authority. Successful completion of the program qualifies the graduate for an educational award. The award represents the College's statement that the graduate has acquired the level of knowledge specified by the marine authority. To obtain the Class I certificate of competency the graduate must fulfill further knowledge and skills during the mandatory three years of watchkeeping experience. Then he is required to be examined to assess his competency. The orals, representing skill assessment, are conducted by the marine authority examiners.

In 1987 the United Kingdom marine authority introduced changes in the examination system. All written examinations were delegated to an educational examination authority, the Scottish Vocational Education Council (SCOTVEC). The SCOTVEC prepared written examination papers and the marine colleges became examination centres. These changes signify the demise of Part A and Part B in the marine engineering examination. The orals are still conducted by the marine authority examiners.

CHAPTER 6

MARITIME EDUCATION AND TRAINING (ENGINEERING) SYSTEMS IN SOME COUNTRIES

In this chapter the Maritime Education and Training systems for engineers of some selected countries, which are based on the long lasting successful training experiences, are discussed. The main reason for choosing these countries is that their training programmes are dissimilar to that used in the Union of Myanmar, which is close to the British system of maritime training, and also they are slightly different from each other. It will be more beneficial to study ones which are different from the present system. By studying them, new ideas can be obtained and the most suitable ones chosen to update the Myanma system.

The discussion is based upon the following facts:

- what system is used
- compliance with STCW 78 Convention
- type of courses and their entry requirements
- level of Certificates of Competency
- level of theoretical studies and course curriculums
- additional courses provided.

The objective is to highlight how some countries have adapted Maritime Education and Training systems for engineers to suit their own local needs. It is useful to examine other countries' systems and to adopt what is appropriate to local social and education systems.

Basic Systems for Maritime Education and Training

There are two basic systems for maritime training. One is the 'hawse pipe' system in which the candidate has to go to sea and get experience first. After he has acquired the recommended sea service he has preparatory courses to take the examinations for his Certificates of Competency. He has the knowledge requirements after the experience has been acquired. The other is the 'front end' system in which the candidate follows a comprehensive undergraduate course and must have the knowledge requirements at this stage. He obtains his Certificates of Competency only after the relevant experience has been acquired.

Nowadays, most countries use the 'front end' system, but the 'hawswe pipe' system still provides for the Certificates of Competency examinations.

6.1 THE UNITED STATES OF AMERICA

Just prior to and during World War II the 'front end' system of education for maritime personnel was provided. Also the traditional 'hawse pipe' system is still provided for licenses which are the Certificates of Competency. All officer licenses are granted based on passing license examinations. The United States Coast Guard controls the examinations and issuance of officer licenses.

6.1.1 Maritime Academies

There are seven academies providing Maritime Education and Training for officers. They are:

1. The United States Merchant Marine Academy - King's Point, New York.
2. State University of New York Maritime College - Fort Schuyler, New York.
3. Maine Maritime Academy - Castine, Maine.

4. Massachusetts Maritime Academy - Buzzards Bay, Massachusetts.
5. Texas Maritime University - Galveston, Texas.
6. California Maritime Academy - Vallejo, California.
7. Great Lakes Marine Academy - Traverse City, Michigan.

The King's Point Academy is run by the Federal government and the others by the state governments. Other academies are quite similar providing course curriculums of 4 years duration. The Great Lakes Academy prepares officers for careers on the lakes and rivers and the duration is three years.

In addition to these academies there are several schools which provide preparatory courses to pass the Coast Guard examinations for licenses.

6.1.2 Courses for Engineers

The King's Point Academy provides the following courses for Bachelor of Science degree:

- Marine Engineering
- Marine Engineering System
- Marine Transportation - A combination programme consisting of management and nautical science
- Dual License - A combination consisting of marine engineering and marine transportation.

State University of New York Maritime College provides:

- Marine Engineering(Conventional Power)
- Marine Engineering(Nuclear Power)
- Naval Architecture
- Electrical Engineering

The other four academies, California, Maine, Massachusetts and Texas provide only one course which is Marine Engineering.

6.1.3 Entry Requirements

The entry requirements for all academies are almost the same. Some entry qualifications for the King's Point Academy are:

- age must be between 17 and 25 years
- must have completed a high school education or equivalent and have taken at least 3 years of English, 3 years of Mathematics and 1 year of Chemistry or Physics with a laboratory in high school
- must have good SAT or ACT results *

* All candidates are required to take the College Board's Scholastic Aptitude Test(SAT) or the American College Testing Program's test(ACT) on scheduled dates at convenient testing centers throughout the country. The basic qualifying scores will be determined by the Academy for each entering class.

6.1.4 Level of Licenses(Certificates)

There are four levels of licenses for unlimited capacity. They are:

1. Chief Engineer of steam and/or motor vessels
2. First Assistant Engineer of steam and/or motor vessels
3. Second Assistant Engineer of steam and/or motor vessels
4. Third Assistant Engineer of steam and/or motor vessels

One year sea service is required between each level license examination. For the first license, the Third Assistant Engineer, examination sea service requirement is three years and graduates from the maritime academies are exempted from this sea service. But they have to take this license examination to qualify for Third Assistant Engineer.

There are also licenses for Chief Engineer(limited-oceans), Chief Engineer(limited-near coastal) and Assistant Engineer(limited-oceans). The license structure is shown in Figure (6).

6.1.5 Teaching Syllabi

All syllabi for marine engineering courses lead to a Third Assistant Engineer license and have a common curriculum in the first two academic quarters of the first year in King's Point Academy. During the second quarter the students decide which of the options to follow. In State University of New York Maritime College all students requiring Third Assistant Engineer license have a common core course for the first two years through the second sea training.

The education and training programme shown in Figure (7), and the curriculum for engineering courses used in King's Point Academy given in Appendix (B).

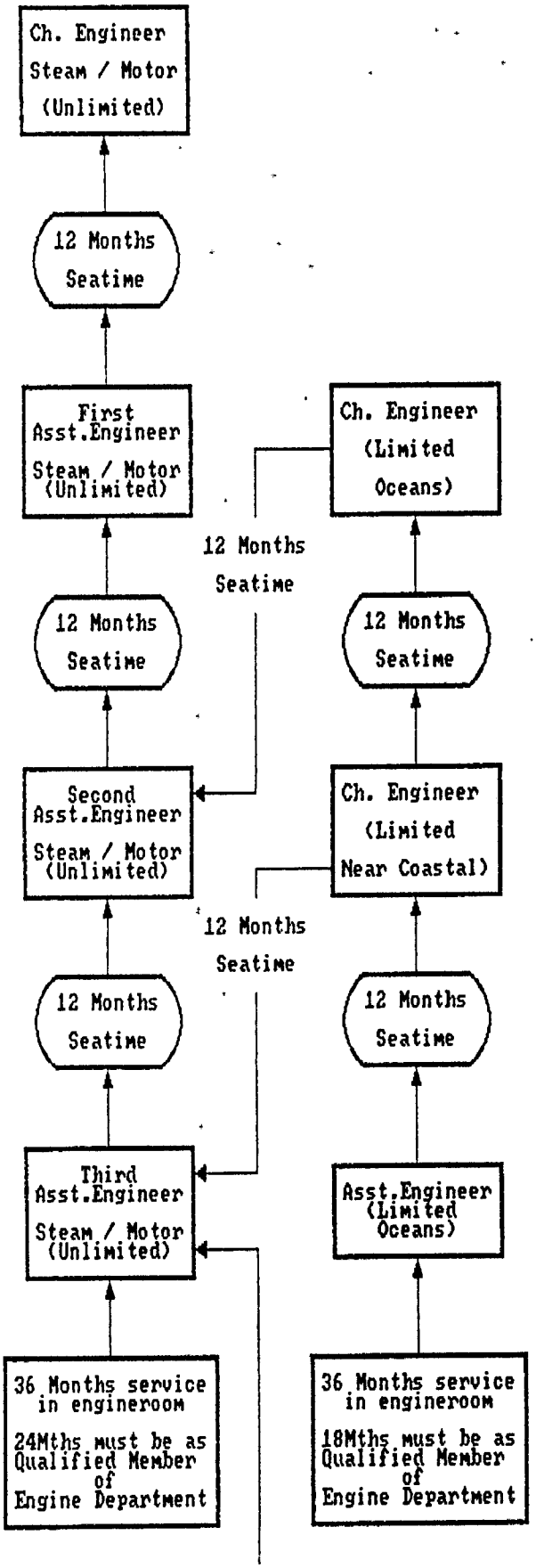
6.1.6 Additional Courses

The King's Point Merchant Marine Academy offers the following short courses:

- Five courses in Diesel Engineering
- Fuel efficiency of Steam Power Plant
- Analysis of Shipboard Vibration

Figure (6)

ENGINEER LICENSE STRUCTURE
UNITED STATES OF AMERICA

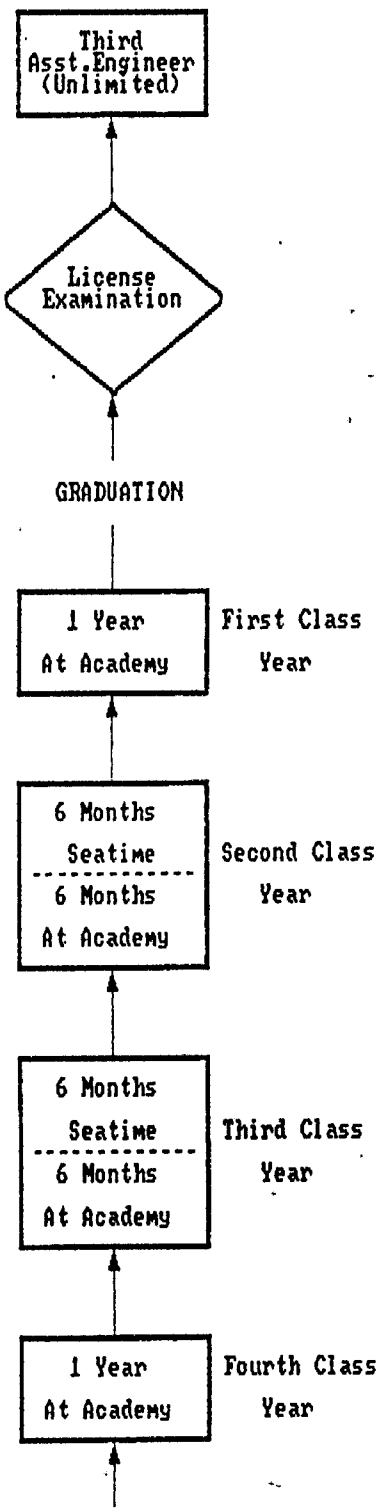


Source: Federal Register Vol.52, No.200

Figure (7)

MARITIME EDUCATION AND TRAINING (ENGINEERING) UNITED STATES OF AMERICA

(Referred to King's Point Merchant Marine Academy Program Sequence)



Source: US Merchant Marine Academy Catalog, 1989

- Master Mariner Readiness Course
- Lifeboat Training and Certification
- Training in Medical Care at Sea
- Computer Application Aboard Ship
- Advanced Fire Fighting.

6.2 FRANCE

The Inspectorate General for Maritime Education and Training in Paris is in charge of the administration, development and supervision of MET in France. Its members control the implementation of MET in the national maritime academies and ensure that equal standards are kept. They decide on the annual intake of students and the entrance conditions. They are in charge of the written and oral examinations for academies' diplomas and certificates of competency.

6.2.1 Maritime Academies

There are four National Maritime Academies in France. They are located in Le Havre, Nantes, Marseilles and Saint Malo. The Le Havre school is the academy with the largest number of students and the Saint Malo is the smallest. The academies in Le Havre and Marseilles operate a radar navigation simulator and Nantes operate an engine room simulator.

6.2.2 The Dual-purpose Course

The Education and Training of Bivalent (Dual-purpose) officers course had been introduced in France in 1967. The officers trained by this system can either sail as master or as chief engineer of a ship. The study programme is well organized and is directed towards the operation of ships with modern technology.

6.2.3 Entry Requirements

The entry requirements for the candidates are:

- must be holder of Baccalaureát C or D in science (12 years of general education)
- must pass the entrance examination.

6.2.4 Levels of Certificates

There are three levels of certificates for maritime officers:

- the First level certificate (unlimited)
- the Second level certificate (for ships less than 7500 grt or 7500 kW)
- the Third level certificate (for coastal ships).

The first and second level officers are now trained in the dual-purpose system and the third level in single purpose.

Dual-purpose First Level Certificate

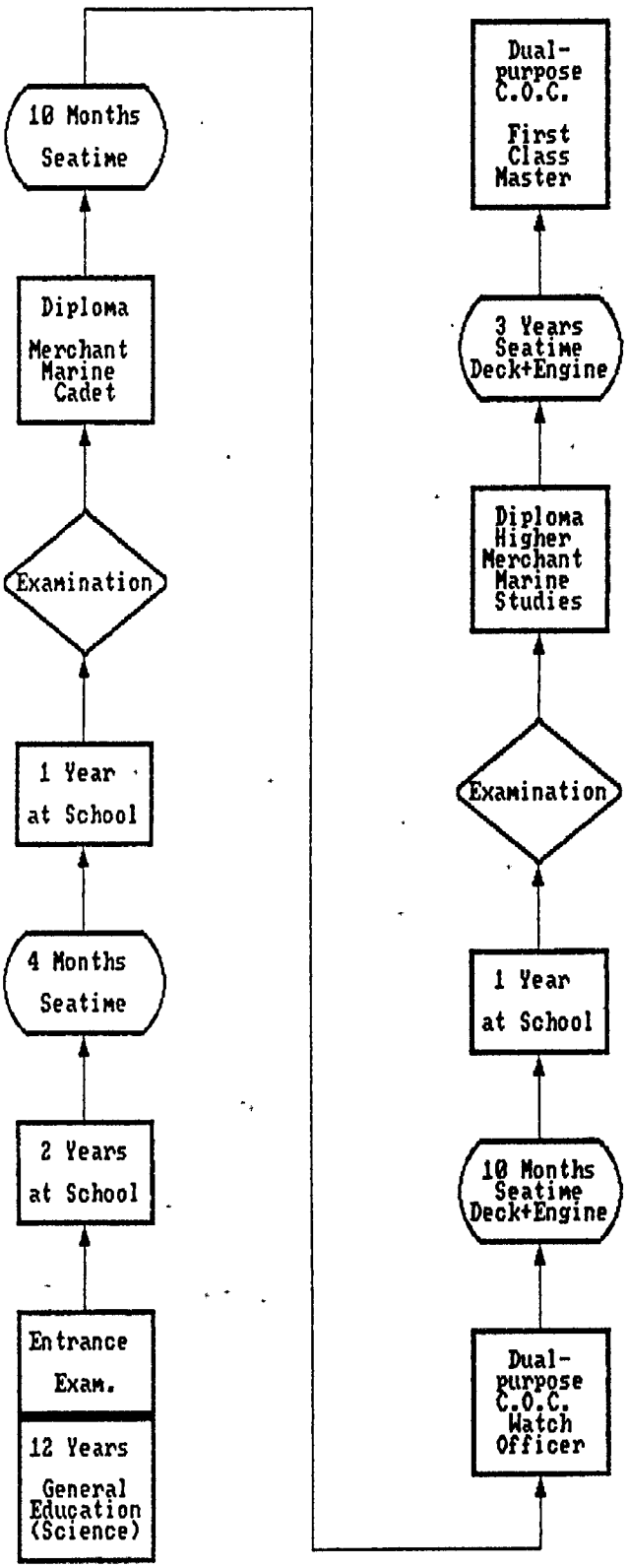
It takes 12 years from entering the programme at the age of 18 to 20 to obtain the highest certificate at an age of 30 or more. A total of 4 years must be studied in one of the national maritime academies and 5 years must be served on board. Four months of this sea service is for cadet seatime at an academy and the remaining 4 years and 8 months must be effective seatime. Since a seaman in France acquires 18 days leave for one month of shipboard service this effective seatime will be completed only at about 8 years. Studies and shipboard service flow diagram shown in Figure (8).

Second Level Certificates

Dual-purpose programme for this level started in France in 1986. This certificate allows the holder to command ships of less than 7500 grt and to be in charge of the engine on ships of less than 7500 kW.

Figure (8)

MARITIME EDUCATION AND TRAINING (DUAL-PURPOSE OFFICERS) FRANCE



Source: A fresh look at education and training of ship officers in France by Professor G.Zade, Maritime Affairs Nr.7/8, 1988

This programme differs in two main aspects from the first level programme. Firstly, the students can enter the programme after 10 years of general education, i.e. 2 years less than required for first level. Secondly, the students are only required to study at a national maritime academy 3 years, i.e. 1 year less. The entire programme can be completed in 11 years.

Third Level Certificates

The training for the certificates of master and engine operators on coastal ships, the third level, is monovalent (single-purpose). No particular level of general education is required but the candidate must have sufficient knowledge in French and basic mathematics. This programme is for the experienced seafarers, nautical or engine, who wish to operate coastal vessels but who did not obtain the general education required for first and second level certificates.

6.2.5 Teaching Syllabi and Examinations

Students for the first level certificate of competency have to attend an average of 31 lectures for a week and each lecture lasts 60 minutes. Duration of the course is 4 years and for each year there are 30 weeks for studies. Detailed syllabi are given in Appendix (C).

The examinations consist of a practical, a written and an oral part. The practical examinations are held by the academies. The written and oral examinations are conducted by the Inspectorate General for MET. Each of the four academies proposes a set of examination papers for all level of certificates to the Inspectorate General in Paris. The written examinations are held nationwide on the same days at the same times for the same subjects.

The oral examinations are held continuously in each academy.

6.3 FEDERAL REPUBLIC OF GERMANY

The Maritime Education and Training system for engineers is a single-purpose course and there is a plan to change to a multi-purpose course in a near future. The Hamburg School of Maritime Studies is now introducing an experimental training course for Ship Operation Officers, who will be licensed for the deck and engine departments.

6.3.1 Maritime Academy

The Flensberg Polytechnic is one of the maritime academies which provides marine engineering courses.

6.3.2 Courses for Engineers

The Flensberg Polytechnic offers the following courses:

1. Chief Engineer Officer CI (Polytechnic degree in Marine Engineering) course, duration 3 years.
2. Chief Engineer Officer CT (State-examined Technician) course, duration 2 years.
3. Chief Engineer Officer CMa (State-examined Technician) course, duration 1½ years.
4. Engineer Officer C Naut course for holders of a German Master's or Deck Officer's Certificate, duration 160 hours.
5. Ship's Electrical Technician (State-examined Technician) course, duration 2 years.

6.3.3 Entry Requirements

For Chief Engineer Officer CI course

- School final certificate (with examination) after 12 years of primary and secondary education,
- Initial training for Ship Mechanic (Multi-purpose

Rating Licensed) and 18 month shipboard service as Ship Mechanic, or

Initial training for approved metal-working or electrotechnical trade and 18 month shipboard service as Engine Room Rating Licensed or shipboard training 12 months as Engineer Officer Assistant, or

Six months basic training in a shipboard, marine engine manufacturing or repair, shipboard training and 18 month shipboard training as Engineer Officer Assistant (see Figure 9).

For Chief Engineer Officer CT course

- School final certificate after 10 years of primary and secondary education,
- Initial training for Ship Mechanic (Multi-purpose Rating Licensed) and 18 month shipboard service as Ship Mechanic or Engine Rating Licensed.

For Chief Engineer Officer CMa course

- School final certificate after 9 years of primary and secondary education,
- Initial training for Ship Mechanic or Engine Rating Licensed.

6.3.4 Licenses(Certificates)

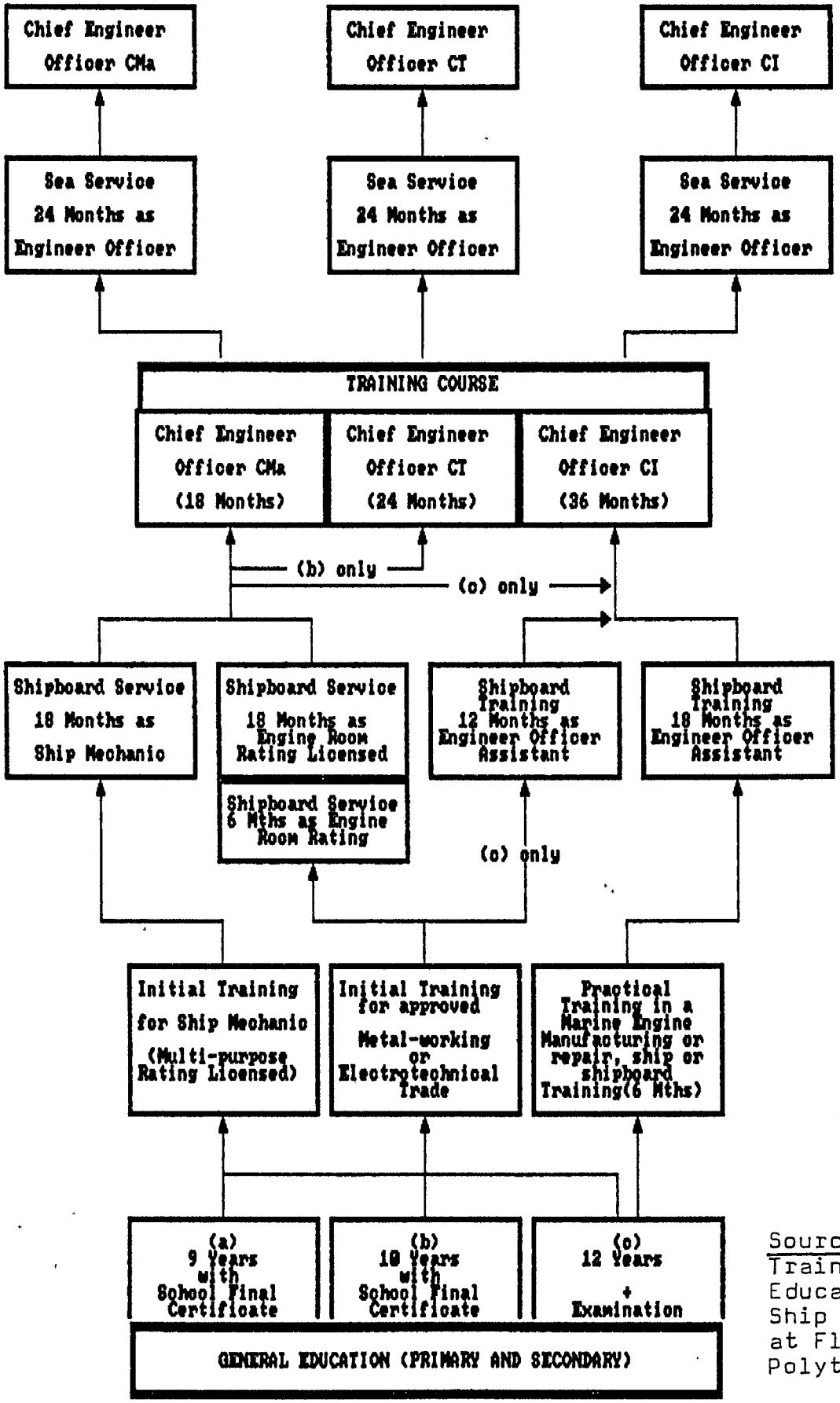
There are three types of licenses and they are:

- Engineer Officer CIW for Chief Engineer Officer of unlimited propulsion power for all trading areas,
- Engineer Officer CTW for Chief Engineer Officer of maximum 8000 kW propulsion power for all trading areas, and
- Engineer Officer CMaW for Chief Engineer Officer of maximum 3000 kW propulsion power for all trading

Figure (9)

MARITIME TRAINING COURSES FEDERAL REPUBLIC OF GERMANY

GENERAL TRAINING SCHEME FOR ENGINEER LICENSES



Source: Training and Education of Ship Engineers at Flensburg Polytechnic(FRG)

areas.

6.3.5 Teaching Syllabi

The duration for Chief Engineer Officer CI course is 3 years and it is divided into 6 semesters. The average lecture hour for a week is 30.

The subjects taught are compiled in agreement with all maritime institutions and provide practical laboratory training in parallel with the theoretical studies.

The syllabus in detail is given in Appendix (D).

6.3.6 Additional Courses

The following short courses are offered at the Flensberg Polytechnic for holders of ship engineer certificates:

- Automation I, duration 3 weeks,
- Automation II, duration 3 weeks,
- Automation III, duration 3 weeks,
- Introduction to Marine Automation for students of World Maritime University, duration 2 weeks,
- Fault Finding in Electrical Plants, duration 1 week
- Heavy Fuel Oil, duration 1 week,
- Pneumatic Automation, duration 1 week, and
- Power Supply Automation, duration 1 week.

6.4 THE NETHERLANDS

As the advance of modern technology on board ships and economical sophistication in ship management makes the concept of the dual purpose officer feasible, a training system was started in 1985 for the higher vocational training of dual-purpose merchant officers. This is known as the Maritime Officer training course and it replaces the single certificate system for unlimited certificates.

6.4.1 The Maritime Officers (Dual-purpose) Course

This is a course of full training and graduation in the nautical discipline and basic in engineering or vice versa. Duration of the course is 4 years. The flow of the training system is shown in Figure (10).

The first and second years constitute the basic study. The student can obtain knowledge and skill required for adequate sea training by the end of the second year.

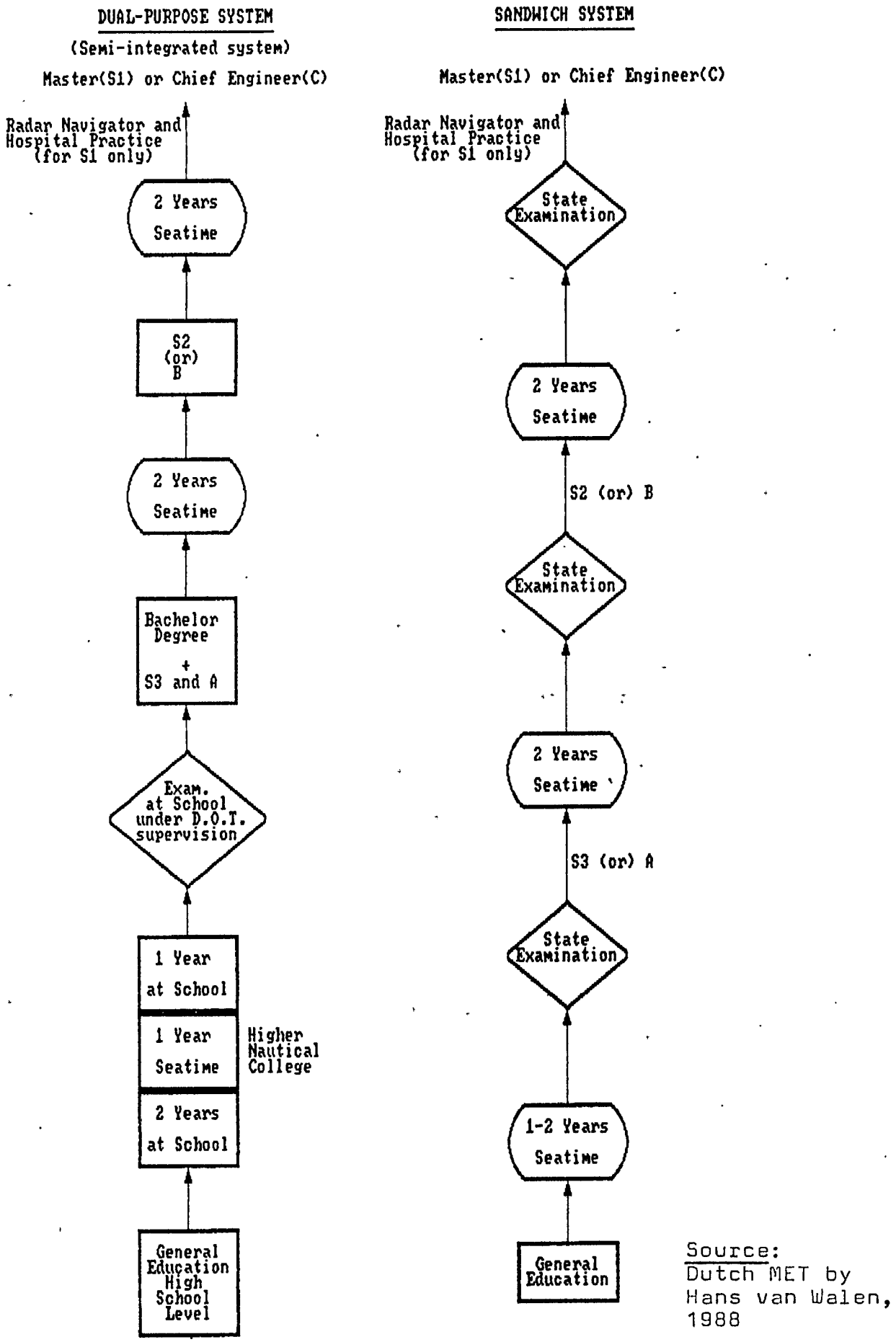
The third year is the sea training year in which period the student can gain experience with all aspects of the maritime industry to be met on board the ship.

The fourth year is the final year and examinations are taken in seven subjects: navigation; instruments; systems; voyage planning and execution; cargo handling technology; collision rules; propulsion plants; auxiliary systems; electric plants. After passing the examinations, the student receives a B.Sc. degree from the Ministry of Education and two watchkeeping certificates(Second Mate and Third Assistant Engineer) from the Ministry of Transport. The distinction in graduation (Bridge or Engine Room) is determined by in-depth variations in the contents of examination subjects. Dependent on the type of graduation, after having required seatime and attending a course in ship science, the highest qualification in either discipline is issued.

Teaching syllabi for shore-based training are given in Appendix (E).

Figure (10)

MARITIME EDUCATION AND TRAINING THE NETHERLANDS



Source:
Dutch MET by Hans van Walen, 1988

6.4.2 Levels of Certificates

There are three levels of certificates and they are:

- Master / Chief Engineer
- First Mate / Second Engineer
- Second Mate / Third Engineer.

A two year sea service is required to perform between each level of certificate. Teaching Syllabi in detail for shore-based training are given in Appendix (C).

6.4.3 Examinations

There are two ways to obtain a certificate of competency: one is through state-examinations and the other through school-examinations.

State-examinations

The state-examinations utilize the sandwich system and the examinations are conducted by the Board of Examiners(BOE) only. There are no requirements regarding preparatory courses, except the possession of the preceding certificates in some cases are required. After passing the examination and acquiring the necessary seatime the candidate receives a certificate of competency. The board is part of the Ministry of Transport and the examiners are appointed by the minister.

School-examinations

These examinations are conducted by the teachers and the state examiners in close cooperation with the Board of Examiners. There are two single certificate systems, one for unlimited and one for limited (less than 6000 gt or 3000 kW) ocean going certificates. The person possessing a limited certificate could get an unlimited certificate by continuing in the sandwich system.

6.5 POLAND

There are two maritime institutions, the Maritime Academy in Gdynia and the Maritime University in Szczecin, providing marine engineering training. The University is under the direction of the Ministry of Transport and Shipping.

6.5.1 Courses for Marine Engineers

The University provides a 5 year course for a Master of Science degree in Marine Propulsion Plant Operation on board merchant and fishing vessels. Also a lower degree, which is a 4 year Bachelor of Science course, has been provided since 1988 and the students who obtained good marks are allowed to attend the M.Sc. course. After obtaining a M.Sc. or B.Sc. degree in Marine Propulsion Plant Operation, the students have to proceed to sea to perform the required seatime for each particular class of certificate of competency.

6.5.2 Entry Requirements

The entry requirements for the marine engineering course are:-

- age not exceeding 23 years
- a certificate from any secondary school
- must pass the entrance examinations
- good health certificate.

6.5.3 Levels of Certificates

There are four levels and they are:

- Chief Engineer Certificate of Competency
- Second Engineer Certificate of Competency
- Third Engineer Certificate of Competency
- Fourth Engineer Certificate of Competency.

Figure (11) shows the training scheme for marine engineers at the University and stages and requirements up to First Class marine engineer certificate of competency.

The total seatime currently required to obtain the highest certificate of competency is 7 years. This, however, is considered too long for a graduate and the seatime requirement to obtain a certificate of competency will be reduced by half, i.e. total 3.5 years in 1990.

6.5.4 Teaching Syllabi

The course for a M.Sc. degree is 5 years divided into 10 semesters and each semester lasts 16 weeks. Duration of a lecture is 45 minutes and the students have 40 hours of lecture and laboratory work for a week. The curriculum contains general subjects and social sciences in the first six semesters. Another four semesters concentrate on vocational and professional subjects. The syllabi in detail are given in Appendix (F).

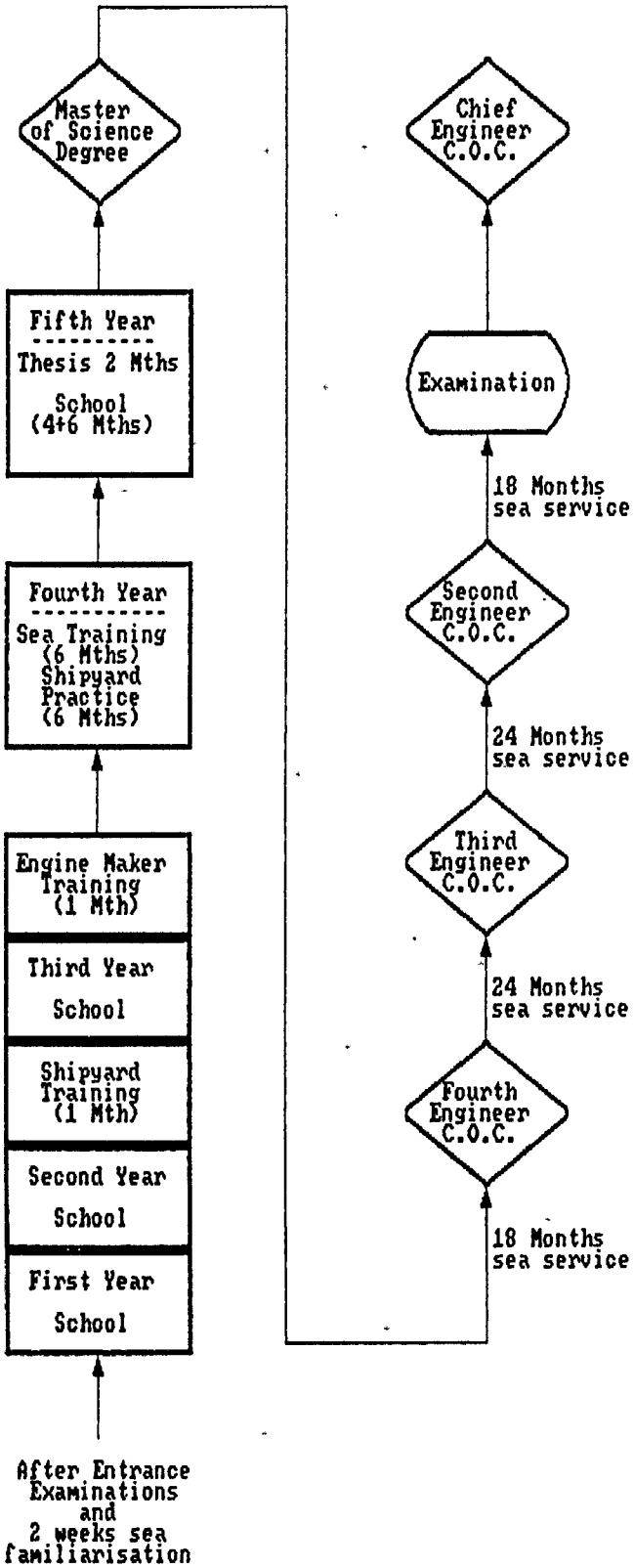
6.5.5 Refreshing and Updating Courses

The following courses are conducted at the Maritime University, Szczecin, for marine engineers:

- preparatory courses for all grades of certificates of competency examinations, duration 4 to 6 months
- course on automation of ship propulsion plants, duration 1 month
- Diesel Engine Room Simulator course, duration 10 days
- course on Marine Environment Protection, duration 1 week
- course on operation of ship's refrigeration plants, duration 10 days.

Figure (11)

MARITIME EDUCATION AND TRAINING POLAND



Source: Education and Training of Ship Engineers at Marine University, Szczecin, by Professor Jerzy Listewnik

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

As stated earlier, a ship is only as good as the men who man it, the human factor has become of great importance. It is obvious, therefore, that the training of maritime personnel must be given high priority. Training must cover job and task requirements from the latest developments in ship operation besides fulfilling already existing needs.

To meet the ever increasing demands of maritime technologies, today's Myanma marine engineers must not only understand the fundamental works of the machinery, but also acquire the following:

- an understanding of modern ship systems as well as of the technology inherent in those system sufficient to effectively operate and maintain them,
- the ability to troubleshoot systems and equipment,
- management skills, and
- ability to apply authority fairly and consistently.

In order to accomplish the international obligations and to upgrade the present training facilities and syllabi used for marine engineering education and training in Myanmar, recommendations are made after every conclusion on each particular subject as the follows:

Course Syllabi

It can be observed, from Chapter 4 of this paper, which parts need to be expanded and developed in the present syllabi. The ever increasing automation and application of electronic devices require us to pay more attention to automation techniques, control engineering, computer science, condition and performance monitoring techniques and troubleshooting in electronic equipment.

Recommendations

The course syllabi need to be reviewed every two years in view of the rapid development of maritime technology. The review should include the methods used, training aids available, scheduling and any other forms of feed back provided in the past years.

As Myanmar is a signatory state to the STCW 78, any modification to the training course syllabi should be assessed in conjunction with this Convention.

Training System

Nowadays most countries use the front-end system of education and training for seafarers. Some of them provide courses leading to first degrees with university recognition. Their maritime education is provided with arrangements for ship-board training, diversifications for employment ashore and opportunities to reach the highest level of university education. Some countries provide pre-sea training courses and students are exempted only from Part A of the examination of Second Class Engineer certificate of competency, like the system now used in the Union of Myanmar. It is known as a step by step system of training and examination. It commences with basic pre-sea training in the Institute of Marine Technology, Yangon, and the dockyards, followed by an on-board practical

training. Then post-sea training follows after requisite sea service at the prescribed appropriate levels prior to the examination for each grade of certificate of competency. In this system the theoretical studies, training and practical experience are well timed and matched. But linking this to an academic system is difficult. Although they have possessed the highest level certificates in their own field and a lot of experience, the marine engineers, trained by this system, have found it difficult to get employment ashore and to do further study abroad when compared to other people who have an academic degree from the universities. They have no diversification for employment nor opportunities to reach the highest level of university education.

Recommendations

A bridged system to get an academic degree should be made in coordination with the authorities of the universities for those who have the highest certificate of competency.

As the present maritime education and training facilities of Myanmar primarily center around ship-manning and do not take into account other needs of the maritime industry, a new marine engineering course should be introduced by modifying the course leading to the award of first degrees of university recognition. This system would cover a full range of studies over a considerably longer period at the pre-sea stage, along with attendant examinations. The course should be designed for engineer officer aspirants to senior positions ashore, associated with the shipping industry. Admission level should be equivalent with entry qualification for engineering colleges. The duration of the course should be five years, including

four years land-based studies and one year practical onboard training. All cadets, both nautical and engineering, should have two years of common study; mathematics, elementary navigation, elementary engineering knowledge, elementary naval architecture, electronics and computer application, in addition to physics-based subjects. After this period, education should be continued in the appropriate specialization. After obtaining a Bachelor degree the students have to proceed to sea to perform the required sea service for each particular class of certificate of competency. The Institute of Marine Technology should provide them with short period preparatory courses for each particular class of certificate of competency.

Dual-purpose Training

The common study in the recommended training programme aims at the preparation for dual purpose training. As the introduction of the dual-purpose training system is one of the various techniques for the reduction of crew costs, most of the developed countries' maritime education and training systems are directed towards this system. It can be observed that some of the developed countries provided this training many years ago. This system also improves onboard working conditions and creates a more flexible manning system. As manning reduction threatens all seafarers, the dual-purposed seafarers may soon emerge and this training would then become mandatory.

Recommendations

To compete with others and to increase employment opportunities, Myanmar should prepare for dual-purpose training. The first step should be to study existing dual-purpose training systems in France and

the Netherlands, as both of these countries are experienced and well recognized in this training.

Training Aids

It can be observed in the syllabi of the leading maritime countries' training programmes that high attention is paid to practical laboratory training to get more effectiveness in training. Their seafarers can study and become familiar with the machinery and equipment, which are sophisticated and difficult to study on board ship, before they go to sea and while they are attending the short termed refreshing courses. As the practical training forms an integral part of the training scheme more practical laboratory work should be required with the aid of necessary training equipment.

The IMO has recommended a list of equipment for training marine engineers, both at the basic and senior engineer officer levels, in the Strategy for Maritime Training book. The Institute of Marine Technology, Myanmar, has some of this equipment. Stability and anchor test tanks, basic electric and electronic laboratories, computer laboratory equipment and automation and control engineering equipment were installed last year and are now used for training purposes.

Nowadays a radar simulator is a compulsory training requirement for deck officers and in the near future engine room simulator training may become compulsory for marine engineers. As simulators allow experience to be gained in those operational situations that are too dangerous, costly, time consuming or impractical to exercise, and provide experience in a short period that would take years to gain on board ship, they are used as

training aids in several countries. As it is highly costly and not essential for engineers, Myanmar does not choose to own and operate one now, but will require one in the future.

Practical shipboard training is given in Myanmar by assigning the cadets to regular merchant vessels of the National Shipping Line engaged in commercial trading. As both are under the same ministry, the Ministry of Transport and Communications, effective communication and understanding are established between the shipboard personnel and the training academy.

Recommendations

To improve the training facilities in the Institute of Marine Technology, Myanmar, all the necessary training equipment should be obtained and utilized to the greatest extent possible. The laboratories and practical workshops of Myanma training academy should be provided with demonstration models, special training devices and other equipment, most of which should be actual ship's apparatus adapted for training purposes. Some of it, such as cutaway models of engine parts, various types of valves, pumps, etc., should be made locally in coordination with the shipping line and the dockyards. Small engines, electric generators and some workshop machines should also be purchased locally. To own highly costly ones, such as an engine room simulator, the authority of the training academy should make a long termed plan. Teaching staff should be sent abroad to study the operation and maintenance of engine simulators. The participation of teaching staff in seminars and symposia concerning this subject matter should be encouraged. As the training vessel is

necessary for all training institutions to provide practical instruction in navigation, seamanship, handling of fire fighting and life saving appliances, machinery operation and maintenance, and other nautical subjects, Myanmar should also plan to own a purposely built training vessel.

Teaching Staff

The success of an occupational educational programme depends largely on having an adequate teaching staff with a thorough understanding of the aims and objectives of the programme and in particular concerns within their area of specialization. It is essential that the teaching staff are properly trained and up to date about the latest technology being used in the field of shipping.

One of the objectives for the IMO in creating the World Maritime University is to help reduce the shortage of suitably trained teaching staff in maritime institutions in the developing countries. Specially designed courses in maritime education and training are offered for students with necessary high qualifications. The courses concentrate on the education and training of lecturers and administrators of maritime education and training institutions. Duration of a course is two years and a Master of Science degree is awarded to the student on completion of the course. The graduate will be able to contribute to the management of maritime education and training institution, his own further development and that of the national maritime infrastructure.

As the students from many different developing countries study together and a number of field studies are arranged to many developing countries, technical cooperation among

nations is encouraged. The courses also cover the examination of seafarers and the investigation of maritime accidents. Availability of fully qualified maritime examiners and maritime educators capable of assisting in maritime accident investigations will help their countries in the adherence to the international standards of maritime training and examination, and in conducting maritime accident investigations.

Recommendations

All efforts should be made to get highly qualified, experienced and dedicated teaching staff at the Institute of Marine Technology, Myanmar. A teachers training programme should be included in the regular activities of the institute. Teaching staff, who have the necessary qualifications, should be sent, in turn, to the World Maritime University to get proper training and to update their knowledge. Each member of the teaching staff should be assigned on board the vessels of the National Shipping Line for a long voyage or six month duration in every three years, on a continuous basis, to refresh himself with ship machinery and equipment. The participation of teaching staff in the National and International educational and professional conferences, seminars and symposia should be encouraged. The link between the training academy and other organizations, such as education departments and universities, ship builders, dockyards, research institutes, both National and International, should be established and strengthened.

Examination System

The examination system for marine engineers presently used in the Union of Myanmar is very similar to the old British

system. All examinations, including theoretical and practical subjects in both written and oral, are conducted by the examiners of the Department of the Marine Administration. As these examiners are also the surveyors of this department they are occupied with much work other than the examinations. To reduce the work load on the examiners and to be more effective the examination system for marine engineers should be changed.

Recommendations

The theoretical subjects written examinations should be delegated to the training academy, the Institute of Marine Technology, Yangon. The subjects will be Part A subjects, which are Mathematics, Heat and Heat Engines, Applied Mechanics and Engineering Drawing. The questions for these examinations should be set up by the teachers of the maritime academy in close coordination with the examiners of the Department of the Marine Administration. For the practical subjects, which are Engineering Knowledge, Naval Architecture and Ship Construction and Electrotechnology, the written examinations, together with the oral examinations of the Engineering Knowledge subjects, should be conducted as usual by the examiners of the Department of Marine Administration.

I make these recommendations on a wide range of subjects. They are intended to encourage consideration of updating facilities and improving procedures for maritime education and training. Some of them will be easy to implement. Others will require long term plans. These recommendations can provide guidance in modifying marine engineering training in the Union of Myanmar.

APPENDIX A

SYLLABI FOR MARINE ENGINEERS' CERTIFICATES OF COMPETENCY EXAMINATIONS USED IN THE UNION OF MYANMAR

Syllabus for First Class Engineer Examination

Fundamental Knowledge Subjects(Part A)

Applied Mechanics

(a) **Statics:** Laws of equilibrium. Moments and couples. Polygon of forces.

(b) **Friction:** Law of dry friction. Friction angle. Friction clutches. Friction on an inclined plane. Work done against friction.

(c) **Kinematics:** Linear and angular motion with constant acceleration. Gravitational acceleration. Velocity-time graphs.

(d) **Relative:** Velocity and acceleration. Relative velocity between bodies moving in different planes.

(e) **Dynamics:** Newton's laws of motion. The force equation. Acceleration of connected bodies. The torque equation. Conservation of momentums. Kinetic energy of translation and rotation. Potential energy. Conservation of energy. Impulsive force. Centrifugal forces. Porter governor. Simple harmonic motion. Simple pendulum. Simple vibrations. Dynamic balancing of masses in one plane. Basic dynamics of the engine mechanism. Use of piston velocity and acceleration formulae.

(f) **Machines:** Velocity ratio. Mechanical advantage. Efficiency.

(g) **Stress and strain:** Direct stress and strain and modulus of elasticity. Shear stress and strain and

modulus of rigidity. Stresses of oblique planes. Resilience due to direct stress. Suddenly applied load.

(h) **Compound bars:** Effects of direct loading and of temperature changes.

(i) **Beams:** Shear force and bending moment diagrams for cantilevers and simply supported beams. Stresses in beams of simple section. Use of simple deflection formulae.

(j) **Torsion:** Torsion equations for solid and hollow round shafts. Torsion of shaft fitted with liner. Horse-power transmitted. Close-coiled helical spring.

(k) **Struts:** Eccentric loading of short columns. Use of strut formulae.

(l) **Thin shell:** Stresses in thin shells. Design of riveted joints. Use of boiler shell design formulae.

(m) **Hydrostatics:** Floatation in two liquids of different specific gravities. Total force and centre of pressure on immersed surface such as tanks and bulkheads.

(n) **Hydraulics:** Bernoulli's equation applied to simple flow problems. Venturimeter. Flow through orifices under constant head,etc. Force exerted by jet on a flat surface perpendicular to the jet.

Heat and Heat Engines

(a) **Elements:** Expansion of solids and liquids including coefficient of expansion. First law of thermo-dynamics and its application to steady flow condition.

(b) **Heat transfer:** Conduction, convection and radiation.

(c) **Properties of steam:** Sensible heat; latent heat; enthalpy; internal energy; volume. Use of steam tables and entropy. Throttling and separating calorimeter.

(d) **Mixtures:** Heat and temperature problems involving two or more substances.

(e) **Gases:** Boyle's and Charles's laws. Characteristic equation. Calculations for expansions and compressions. Simple application of Dalton's law of partial pressure.

(f) **Gas Cycles:** Use of entropy charts. Constant volume cycle. Diesel cycle. Open and close cycles for gas turbines. Indicated and brake thermal efficiencies. Mechanical and overall efficiencies.

(g) **Expansion of steam:** Throttling. Hypothetical PV diagrams. Work done, m.e.p., diagram factor, including effect of clearance. Compounding. Mean referred pressure. Total power. Combined diagrams. Reuleaux valve diagram.

(h) **Steam cycle:** Basic Rankine cycle. Equivalent evaporation. Efficiencies.

(i) **Density and scale:** Basic calculations on the effect of condenser leakage and impure feed on the density and scale in boilers. Basic calculations on evaporator performance.

(j) **Turbines:** Basic cycle and its modifications. Flow through nozzles. Blade diagrams for impulse and reaction turbines. Forces and work done on blades. Use of total heat charts to determine steam condition at various stages.

(k) **Combustion:** Combustion equations. Calculation of theoretical air required. Determination of calorific value. Basic analysis of exhaust gases.

(l) **Refrigeration:** Reversed Carnot cycle. Vapour compression cycle. Coefficient of performance.

Mathematics

(a) **The solution of equations:** Quadratic equations.

Simultaneous quadratic equations.

(b) **Graphs:** The determination of laws. The graphic solution of equations. The equation of straight line. The determination of laws of linear form. The ellipse. The cubic and other equations.

(c) Permutations. Combinations. The Binomial Theorem.

(d) **Function. Limit. Infinitesimal:** Definition of a function. The notion of a limit. Differential coefficient.

(e) Differentiation of functions of a single variable.

(f) **Integration:** The constant of integration or the arbitrary constant.

(g) **Some applications of Calculus:** Velocity and acceleration. Maxima and minima.

(h) **Trigonometry:** Measurement of angles. Graphs of trigonometric functions. Period of circular function. The solution of trigonometrical equations. Compound angles. The solution of triangles.

(i) **Differentiation and integration of trigonometrical functions:** Products and quotients. The differentiation of powers of the trigonometrical functions. Applications. Simple harmonic motion. Integration of the circular functions.

(j) The Definite Integral, Mean values. Simpson's rule.

(k) **Physical applications of Integration:** Centre of gravity. Moment of inertia.

(l) The Exponential. Hyperbolic and logarithamic functions.

(m) **Some standard methods of Integration:** Integration by substitution. Integration of products of circular functions. Integration by parts.

(m) The complex number.

Practical Knowledge Subjects(Part B)

Electrotechnology

(a) **The magnetic and electric circuits:** Hysteresis. Electromagnetism. Kirchoff's laws.

(b) **Distribution systems:** D.C. 2-wire and 3-wire. A.C. single-phase and three-phase 3-wire and 4-wire. Balancer in 3-wire d.c. system.

(c) Motor starters.

(d) **Applications:** Parallel operation of shunt and compound generators. Applications to Ward Leonard system. Faults and maintenance of machines.

(e) **A.C.:** Production of an alternating wave form. The sine law. R.M.S.and average values. Form factor.

(f) The series and parallel circuits.

(g) **Alternators:** Construction. Synchronising and reference to load sharing.

(h) **Motors:** Induction and synchronous types. Single phase motors.

(i) **Propulsion:** Types using D.C.and A.C.machines. Advantages and disadvantages of electric propulsion.

(j) **Single-phase motors:** Description of general common types. Starting.

(k) **Transformers:** Elementary principles and general description.

(l) **Instruments:** Simple treatment of dynamometer, wattmeter, frequency meter, power factor meter, rotary synchroscope.

(m) Thermionics.

Naval Architecture and Ship Construction

(a) **General:** Form coefficients. Wetted surface formulae. Simpson's first rule applied to areas, moments of areas, second moments of areas,etc.

(b) **Transverse stability:** Centre of gravity and buoyancy. Metacentre. Moment of statical stability. Cross curve of stability. Hydrostatic curves. Effect of free liquid surface and subdivision of tanks.

(c) **Longitudinal stability:** Longitudinal B.M.and G.M.and statical stability. Centre of floatation. Moment of change of trim.

(d) **Draught, trim and heel:** Changes due to adding or removing fuel, ballast or cargo,etc.

(e) **Resistance and propulsion:** Derivation of Admiralty and fuel coefficients. The law of corresponding speeds. Froude's law of comparison. Simple problems on propellers. Slips.

(f) **Ship construction:** Forces on ship under various conditions. Construction of all parts of steel ships. Structural fire protection arrangements. Bilge and ballast arrangements. Dry docking. Ventilations. Common terms used in modern steel ships and in tonnage measurement. Tonnage measurement rules.

Engineering Knowledge

(a) Materials commonly used in the construction of marine engines and boilers and the mechanical tests to which these materials are normally subject.

(b) Heat and combustion. The properties of steam, fuel, lubricants and other liquids, gases and vapours used in machinery on board ship.

(c) The use, constructional details and principles involved in the action of the pressure gauge, thermometer, barometer and other meters commonly used.

(d) The causes, effects and usual remedies for incrustation and corrosion. Feed water and blow densities and scale formation.

(e) Constructional details and working principle of marine

engines. The principles of working and methods of calibration of dynamometers and torsion meters. The method of dealing with wear and tear of machinery and boilers. The alignment of machinery parts. Temporary and permanent repairs in the event of breakdown.

(f) Application of indicator. Calculation of horse-power.

(g) Constructional details and principles of action of pumps and oily water separators. The general requirements concerning feed, fuel, bilge, ballast systems.

(h) The constructional arrangement, details and working of steering gears, refrigerating machinery, hydraulic and other auxiliary machineries.

(i) Precaution against fire or explosions due to oil or gas. Flash point. Explosive properties of gas given off by fuel or lubricating oils. Spontaneous combustion. Fire detection. Methods of dealing with fire. Action and maintenance of mechanical and chemical fire extinguishers and other fire-fighting appliances.

(j) Methods of constructing marine steam engines and boilers.

(k) The various types of propelling and auxiliary machinery now in use.

(l) Constructional details and working of evapoprators, feed water heaters and feed water filters.

(m) Marine boilers of various modern designs. Prevention of movement of boilers when vessels are pitching or rolling. The determination by calculation of suitable working pressures for boilers of given dimensions.

(n) Use and management of boiler mountings, with special reference to safety valves and water level gauges. Water hammer.

(o) Construction details, operation and maintenance of installations for superheating steam and burning coal

or oil fuel.

(p) The principles of working of internal combustion engines. The difference between various types of engines. Constructional details of internal combustion engines.

(q) Properties of fuel and lubricating oils generally used in internal combustion engines. The supply of air and fuel to cylinders of engines of different types. Cooling engine parts. Constructional details and working of air compressors.

(r) Methods of constructing marine diesel engines. Methods employed in fitting the machinery on board.

(s) Starting and reversing arrangements and various operations connected therewith.

(t) The attention required for operation and maintenance of various parts of machinery. The use and management of valves and safety devices employed.

(u) Enumeration and description of defects arising from working of machinery. The remedy for such defects.

(v) Constructional details and management of auxiliary steam boilers, their fittings and mountings, with special reference to water gauges and safety valves. Oil fuel and combustion equipment.

(w) The administrative duties of a chief engineer. Organization of engine room staff for emergency duties and the use of safety equipment. Organization of repairs and surveys. Report to owner.

(x) The recognition of irregularity in the running of engines from indicator diagrams. The rectification of these irregularities.

Syllabus for Second Class Engineer Examination

Fundamental Knowledge Subjects(Part A)

Mathematics

(a) **Arithmetic:** Conversion of physical quantities involving length, area, volume or force from one system units to another. Ratio and proportion. Percentages.

(b) **Algebra:** Indices. Use of common and Naperian logarithms. Simplification of algebraic expression. Simple and quadratic equations,etc.

(c) **Graphical work:** Simple graph of statistics. Graphical solution of simple simultaneous equations.

(d) **Trigonometry:** Measurement of angles. Sine, cosine and tangent of angles. Solution of triangles.

(e) **Geometry:** Properties of triangles. Isosceles and equilateral triangles.

(f) **The circle:** Properties of chords and tangents,etc.

(g) **Mensuration:** Areas of triangles, polygon, circle,etc. Areas of oblique sections of regular solids of uniform cross-section. Use of Simpson's first rule. Volume and surface areas of prisms, pyramids, spheres, etc.

Applied Mechanics

(a) **Statics:** Force as a vector. Triangle and polygon of forces. Moment of forces. Moments of areas and volumes. Centroids and centre of gravity.

(b) **Machines:** Simple lifting machines. Linear law. Velocity ratio. Mechanical advantage and efficiency.

(c) **Hydraulic:** Flow through orifice. Co-efficients of velocity, contraction of area and discharge.

(d) Friction, Kinematics, Dynamics, Stress, Beams, Torsion, Thin shell and hydrostatics as in First Class

syllabus.

Heat and Heat Engines

(a) **Heat and heat transfer:** Units. Specific heat. Mechanical equivalent of heat. Heat transfer by conduction, convection and radiation.

(b) **I.C.engines and air compressors:** Elementary principles and cycle of operation. Calculation of work done.

(c) **Reciprocating steam engines:** Hypothetical and actual indicator diagrams. Indicated and brake horse-power. Thermal, mechanical and overall efficiencies.

(d) **Steam turbine:** . Elementary principles. Efficiencies.

(e) Mixtures, gases, properties of steam, combustion and refrigeration as in First Class syllabus.

Practical Knowledge Subjects(Part B)

Electrotechnology

(a) **General:** Electric current by chemical, magnetic, thermal and production of light. Electro motive force.

(b) **Electric circuit:** Units. Series and parallel circuits. Joule's equivalent, conductor resistance, specific resistance. Temperature co-efficient of resistance. Applications of steering gears, pyrometers,etc.

(c) **Electrolytic action:** Uses of electrolysis. Faraday's laws. Electro-chemical equivalent.

(d) **Cells:** Primary and secondary cells. Maintenance.

(e) **Magnetism and electromagnetism:** Magnetic field. Relative direction of current and field. Flux density. Permeability. Faraday's and Lenz's laws.

(f) **A.C.:** Sinusoidal wave, frequency, maximum, r.m.s.and average values.A.C.circuit. Inductor and capacitor.

Resistance, reactance and impedance.

(g) **Instrument:** Switch board indicating instrument. Moving coil, moving iron and dynamometer types. Use of shunt and series resistances. Current transformer. Simple ohmmeter and insulation test.

(h) **Circuits:** Single wire, 2-wire, 3-wire and ring main systems for d.c. Use of fuses and circuit breakers. Earth lamps. Parallel running and synchronising.

(i) **Electrical machines:** Construction, general and details. Field circuits. Commutation. Windings. Maintenance.

(j) **D.C.generators and motors:** Protections. Excitation. Voltage control. Parallel operation. Types of starters. Speed control and load characteristics.

Naval Architecture

(a) **General:** Displacement. Wetted surface. Coefficient of forms. Application of Simpson's first rule.

(b) **Buoyancy:** Alteration of draught due to change of density of water. Buoyancy and reserve buoyancy. Effect of bilging.

(c) **Transverse stability:** Shift of c.g.due to ballasting, etc. Stability at small angle of heel.

(d) **Resistance and propulsion:** Admiralty and fuel coefficients. Relation between speed and fuel consumption. Pitch, apparent slip, wake, power, etc.

(e) **Structural strength:** Simple problems on strength of structural members. Loading due to head of liquid.

(f) **Ship construction:** Common terms used in measurements. Definitions of shipbuilding terms. Structural members in ordinary types of steel ships. Machinery seating arrangements. Watertight bulkheads. Double bottom tanks. Ventilation arrangements. Fire detection and extinguishing arrangements. Tanks filling and pumping

arrangements. Drydocking and maintenance of under-water fittings.

Engineering Knowledge

Same as items in First Class syllabus excluding items (w) and (x).

Source: Notification Numbers 166 and 173 - Rules relating to the Examinations of Second and First Class Engineer's Certificate of Competency, 1968 and 1970, Myanmar.

APPENDIX (B)

Curriculums for MET (Engineering) in the USA

King's Point Merchant Marine Academy

First Year

First and Second Quarters

Common Curriculum	Credit Hours
1. Calculus and Analytic Geometry I, II	8
2. Computer Usage	0.5
3. Physics I, II	7
4. English I, II	6
5. Engineering Graphics I, II	2
6. Marine Safety I	2
7. Introduction to Nautical Science I	5
8. Introduction to Marine Engineering I	3
9. Engineering Shop I	1
10. Physical Education	2
Total	36.5

Third and Fourth Quarters

Common Curriculum	
1. Calculus and Analytic Geometry III, IV	8
2. Physics I, II	7
3. Chemistry I, II	8
4. Fundamental of Naval Science	3
5. Safety of Life at Sea	1.5
6. English III	3
7. Physical Education	2

Dual License	
1. Engineering Graphics III	1
2. Introduction to Marine Engineering II	2.5
3. Introduction to Electrical Engineering	2.5
4. Engineering Shop II	2
5. Metal Cutting Processes	1.5
6. Nautical Science IV	5

Engineering	
1. Engineering Graphics III	1
2. Introduction to Marine Engineering II	2.5
3. Engineering Graphics IV	1
4. Introduction to Electrical Engineering	2.5
5. Engineering Shop II	2
6. Metal Cutting Processes	1.5
7. Metal Joining Processes	0.75

Marine Engineering Curriculum

Second Year

1. Introduction to Differential Equations	4
2. Physics III, IV	7
3. Introduction to Computer Science	3
4. Introduction to Materials Engineering	3.5
5. Engineering Mechanics	7
6. Thermodynamics I	3.5
7. Safety at Sea I	1.5
8. Naval Weapons Systems	3
9. Economics I, II	6
10. Physical Education	2
Total	40.5

Third Year

1. Strength of Materials	4.5
2. Principles of Naval Architecture	3
3. Fluid Mechanics I, II	4.75
4. Thermodynamics	3.5
5. Heat Transfer	2.25
6. Electric Circuits I, II	7.5
7. Naval Operations I	3
8. History I	3
9. Managerial Process	3
10. Elective	3
11. Introduction to Sailing	1
Total	38.5

Final Year

1. Marine Refrigeration	3.75
2. Alternating Current Machinery	3.75
3. Electronics I	3.75
4. Marine Engineering I, II, III	13.25
5. Internal Combustion Engines I, II	7.5
6. Naval Operations II	3
7. History II, III	6
8. Humanities or Comparative Culture	9
9. Marine Transportation	3
10. Electives	15
11. Physical Education	2
Total	70

Marine Engineering System

Second Year

Same as Marine Engineering curriculums.

Third Year

1.	Differential Equations I	4
2.	Strength of Materials	4.5
3.	Principles of Naval Architecture	3
4.	Fluid Mechanics I, II	4.75
5.	Thermodynamics II	3.5
6.	Heat Transfer	3.25
7.	Electric Circuits I, II	7.5
8.	Naval Operations	3
9.	History I	3
10.	Introduction to Sailing	1
	Total	37.5

Fourth Year

1.	Fundamentals of Engineering Design	3
2.	Machine Design I	3
3.	Ship Resistance and Propulsion	3
4.	Marine Refrigeration	3.75
5.	Alternating Current Machinery	3.75
6.	Electronics I	3.75
7.	Marine Engineering I, II, III	13.25
8.	Internal Combustion Engines I, II	7.5
9.	Automatic Control Systems I	3.75
10.	Design Electives	6
11.	Naval Operations II	3
12.	History II, III	6
13.	Humanities or Comparative Culture	9

14. Marine Transportation	3
15. Physical Education	2
Total	73.75

Dual-license Curriculum

Second Year

1. Shipboard Training Program-First Sea Period	14
2. Introduction to Differential Equations	4
3. Physics III, IV	7
4. Metal Joining I	0.75
5. Introduction to Computer Science	3
6. Engineering Mechanics I, II	7
7. Thermodynamics I	3.5
8. Business Law	2
9. Maritime Law	3
10. Economics I, II	6
11. Naval Weapons Systems	3
12. Introduction to sailing	1
Total	54.25

Third Year

1. Strength of Materials	4.5
2. Principles of Naval Architecture	3
3. Fluid Mechanics I, II	4.75
4. Thermodynamics II	3.5
5. Heat Transfer	2.25
6. Electric Circuits I, II	7.5
7. Marine Electronics I	3
8. Marine Materials Handling II	3
9. Seamanship I	2
10. Navigation I	4
11. Meteorology	4

12. Physical Education	1
13. Shipboard Training Program-Second Sea Period	15
Total	57.5

Final Year

1. Marine Refrigeration	3.75
2. Alternating Current Machinery	3.75
3. Marine Engineering I, II, III	13.25
4. Internal Combustion Engines I, II	7.5
5. Naval Operations I, II	6
6. History I, II, III	9
7. Humanities IV	3
8. Managerial Process	3
9. Principles of Transportation	3
10. Marine Safety II	3
11. Communications	1
12. Seamanship II	3
13. Navigation	2
14. Navigation Laboratory	1
15. Bridge Watch Standing	3
16. Marine Electronics III, IV	6
17. Senior License Seminar	2
18. Financial Management	3
19. Physical Education	2
Total	78.25

* 1 Credit Hour = 1 Class Hour/week = 2 Lab. Hours/week

Source: U.S. Merchant Marine Academy Catalog, 1988-1989

APPENDIX (C)

Maritime Education and Training in France

Syllabus of Dual-purpose First Level Certificate

The figures given are hours/week and there are 30 weeks of study in each year.

First Year

Courses	
Mathematics	3.00
Electricity	1.50
Nautical Astronomy	1.50
Navigation	4.00
Thermodynamics, Ship's Machinery	4.00
English Language	3.00
Maritime Law	1.00
Ships Technology and Equipment, Collision Avoidance, Port Signals	1.00
Workshop Technology and Machinery Equipment	2.50
Technical Drawing	3.00
Electronic Data Processing	2.00

Laboratories	
Electricity	1.00
Fuel Oil, Lube Oil, Boiler Water Analysis	0.50
Workshop and Machinery Equipment	1.50
Signals and Communication Equipment and Procedures	0.50
Navigation	0.50

Seamanship-First Aid	
Rope Work - Life Saving Appliances and	
Survival	0.75
Techniques	0.75
Life Boats	1.00
First Aid	1.00
Total	33.25

Second Year

Courses	
Mechanics and Strength of Materials	3.00
Electricity	2.00
Radioelectricity, Electronics	1.50
Fluid Mechanics and Ship's Machinery	4.00
English Language	3.00
Navigation, Nautical Calculation, Chartwork	4.00
Maritime Law	0.75
Ship Construction	0.75
Technical Drawing, Plan Reading	3.00
Automation	1.00
Electronic Data Processing	2.00
Laboratories	
Ship's Machinery	1.50
Electricity	1.50
Electronics (every 3 weeks 1.50 hrs.)	0.50
Navigation	1.00
Automation	1.00
Total	30.50

Third Year

Courses	
Electricity	1.50
Radioelectricity, Electronics	1.50
Ship's Machinery	5.00
English Language	3.00
Ship Stability	0.75
Navigation, Nautical Calculation, Chartwork	2.25
Ship Handling	0.25
Commercial Law	1.00
Cargo Handling	0.75
Automation	2.00
Meteorology	1.00
Collision Avoidance Regulations, Aids to Navigation, Port Signals	0.50
Safety	1.50
Laboratories	
Ship's Machinery	1.00
Engine Practice	3.00
Electricity	3.00
Electronics	1.00
Navigation	1.00
Automation	1.00
Conferences, workshops, shipyards and factory visits average time	1.00
Total	32.00

Fourth Year

Courses	
Electricity	1.50
Radioelectricity, Electronics	2.50
Ship's Machinery	1.50
English Language	3.00
Ship Stability	1.50
Navigation	1.25
Rules and Regulations	1.00
Ship Handling	0.75
Ship Protest	1.50
Cargo Handling	1.00
Collision Avoidance Regulations	
Radar Simulator	1.50
Ship's Accidents, Damage Repair, Safety	1.50
Automation	2.50
Maritime Trade	1.00
Claims and Accountancy	1.50
Shipboard Sanitation	0.50
Laboratories	
Electricity	1.50
Electronics	3.00
Automation	1.50
Shipboard Sanitation	0.50
Meetings, Visits	2.00
Total	32.50

Source: MET in France (Handout), by Professor G. Zade

APPENDIX D

Syllabus for Maritime Education and Training (Engineering) in the Federal Republic of Germany

Fundamental Study	Teaching hours per week		
	1st Sem.	2nd Sem.	3rd Sem
1. Maritime Law and Economics	2	2	
2. Engineering English	2	4	
3. Mathematics	6	4	2
4. Data Processing Basics			2
5. Experimental Physics	4	2(2)	
6. Experimental Chemistry	2	2	(2)
7. Material Technology	2	2(2)	
8. Engineering Mechanics	4	4	4
9. Electricity Basics	2	2	4(2)
10. Control Engineering		2	2(2)
11. Thermodynamics	4	4	6
12. Technical Drawing	2		
13. Machine Components			4
Total hours per week	30	32	30

( ) laboratory

Advanced Study	4th Sem.	5th Sem.	6th Sem
1. Shipping Policy and Management		2	2
2. Machinery Dynamics	2	2	
3. Applied Control Engineering	2(2)	2	
4. Electrical Machinery	2(2)	(2)	2
5. Electrical Plants		2	2

6. Electronics and Digital Control	2(1)	2(2)	
7. Basic Nuclear Engineering		1(1)	2
8. Naval Architecture and Propulsion			4
9. Heat Economics			4
10. Turbines	2	2	2
11. Boilers	2(1)	2(2)	
12. Internal Combustion Engines	4(2)	4(2)	2
13. Auxiliaries	2(2)	2(2)	2
14. Operation Management			2
15. Subjects free of choice	2		2
16. Diploma Thesis			4
Total hours per week	30	32	30

( ) laboratory

Source: The Training and Education of Ship Engineers at Flensburg Polytechnic (FRG), 1989

APPENDIX (E)

Syllabus for Maritime Education and Training Dual-purpose System in the Netherlands

General Subjects	1st Year	2nd Year
- Dutch Language	1	-
- English Language	1	1
- Law	1	-
- Business Management	1	1
- Pre-sea, First Aid and Health	1	1
Science subjects		
- Mathematics	4	1
- Physics, Mechanics (lab. practice included)	6	2
- Data Processing	2	1
Vocational subjects		
- Automation Techniques	3	3
- Electric Installation	2	4
- Naval Architecture	1	1
- Radio-telephony	-	1
Navigation subjects	5	9
- Manoevring		
- Meteorology and Oceanography		
- Practice		
- Navigation, instruments and systems		
- Passage Planning		

- Cargo and Loading Technology		
- Collision Rules		
Marine Engineering subjects	6	9
- Engineering lab.		
- Practice		
- Technology		
- Propulsion systems		
- Auxiliary systems.	---	---
Total	34	34

Fourth Year

Part 1

Tests	N	E
- Health	1	1
- Automation	2	2
- Naval Architecture	1	1
- Manoeuvring	1	1
- Meteorology and Oceanography	1	1
- Practice Laboratory machines and Electric plants	2	2

Part 2

Examinations

- Navigation, instruments, systems		
- Voyage Planning and Execution		
- Cargo handling technology	10	4
- Collision Rules		
- Propulsion Rules		
- Auxiliary Systems	4	10
- Electric Plants		

Part 3

- Thesis	3	3
- Obligatory Supplement(optional)	3	3
	---	---
Total	28	28

The figures shown above are the periods per week and each period lasts 50 minutes.

APPENDIX (F)

Syllabus for Maritime Education and Training (Engineering) in Poland

General and social sciences subjects

- English	352 Hrs.
- History of Philosophy	96
- Science of Economy	96
- Mathematics	320
- Physics	144
- Chemistry.	64

General technical subjects

- General Mechanics	128
- Strength of Materials	160
- Theory of Vibrations and Machine Dynamics	80
- Descriptive Geometry	64
- Technical Drawing	64
- Principles of Engine Construction	144
- Theory of Machinery	80
- Hydromechanics	48
- Thermodynamics	176
- Heat Exchange	32
- Principles of Automatics	96
- Principles of Electrotechniques and Electronics.	96

Vocational subjects

- Principles of Ship Building	32
- Nautical Principles	24

- Ship's Firefighting	32 Hrs.
- Sea Environment Protection	36
- Fleet Organization and Technical Economic Operation	24
- Knowledge of Ship's Materials	144
- Plant Repairing Techniques	112
- Production and Assembling Techniques	80
- Ship's Internal Combustion Engines	176
- Ship's Steam Turbines	80
- Ship's Boilers	32
- Auxiliar Engine Room Machinery	160
- Deck Machinery	32
- Refrigeration, Air Conditioning and Ventilation	80
- Ship's Propulsion Plants	144
- Diagnosis of Propulsion Plant Machinery and Systems	60
- Ship's Electrotechnics	64
- Ship's Power Plant Automation.	80

The syllabus also includes machining and welding at the University workshop.

Source: Education and Training of Ship Engineers at Marine University in Szczecin by Professor J. Listewnik

H. MERCHANT SHIPPING.

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THE BURMA MERCHANT SHIPPING ACT.

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THE BURMA MERCHANT SHIPPING ACT.[1]

[INDIA ACT XXI, 1923.] (1st May, 1923.)

PART I.

INTRODUCTORY.

1. * * * *

Definitions.

2. In this Act, unless there is anything repugnant in the subject or context,—

(1) "effects" includes clothes and documents ;

(2) "foreign-going ship" means a ship, not being a home-trade ship, employed in trading between any port in the Union of Burma and any other port or place ;

(3) "home-trade ship" means a ship employed in trading between any ports in the Union of Burma or between any port in the Union of Burma and any port or place in India or Pakistan or in the Straits Settlements, or in the Island of Ceylon ;

(4) "master" includes every person (except a pilot or harbour-master) having command or charge of a ship ;

(5) "Merchant Shipping Acts" means the Merchant Shipping Acts, 1894—1932 ;

(6) "passenger" includes any person carried in a ship other than the master and crew and the owner, his family and servants, but does not include any persons on board the ship either in pursuance of the obligation laid upon the master to carry ship-wrecked, distressed or other persons, or by reason of any circumstance which neither the master nor the owner could have prevented or forestalled ;

(6A) "passenger steamer" means a steamship carrying more than twelve passengers ;

(7) "prescribed" means prescribed by rules made under this Act ;

(8) "seaman" means every person (except masters, pilots and apprentices duly indentured and registered) employed or engaged in any capacity on board any ship ;

(9) "steam-ship" means every description of vessel used in navigation and propelled wholly or in part by the agency of steam ;

(10) "wages" includes emoluments ; and

[2] (11) * * * *

Application of Act to ships propelled by electricity or mechanical power.

3. The provisions of this Act applying to steam-ships shall apply to ships propelled by electricity or other mechanical power, with such modifications as the President of the Union may, by notification in the Gazette, direct for the purpose of adaptation.

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[1] For provisions relating to the registration of Government and other ships, *see* the Burma Registration of Ships Act (*post*).

[2] Omitted by the Union of Burma (Adaptation of Laws) Order, 1948.

(2) Scales of the fees payable for the time being shall be conspicuously placed in the shipping office, and all shipping-masters, their deputies, clerks and servants may refuse to proceed with any engagement unless the fees payable thereon are first paid.

(3) Every owner or master of a ship engaging or discharging any seaman in a shipping office or before a shipping-master shall pay to the shipping-master the whole of the fees hereby made payable in respect of such engagement or discharge, and may, for the purpose of in part reimbursing himself, deduct in respect of each such engagement or discharge from the wages of all persons (except apprentices) so engaged or discharged and retain any sums not exceeding the sums specified in that behalf in Table B in Schedule I :

Provided that, if in any cases the sums which the owner is so entitled to deduct exceed the amount of the fee payable by him, such excess shall be paid by him to the shipping-master in addition to such fee.

(4) For the purpose of determining the fees to be paid upon the engagement and discharge of seamen belonging to foreign-going ships which have running agreements as hereinafter provided, the crew shall be considered to be engaged when the agreement is first signed, and to be discharged when the agreement finally terminates : and all intermediate engagements and discharges shall be considered to be engagements and discharges of single seamen.

Prohibition on taking other remuneration at shipping office.

10. If a shipping-master, deputy shipping-master, clerk or servant in a shipping office demands or receives, other than the fees authorized under this Act, any remuneration whatever, either directly or indirectly, for hiring or supplying any seaman for a ship or transacting any business which it is his duty to transact, he shall be liable for every such offence to a fine which may extend to two hundred rupees, and shall also be dismissed from his office.

Certificates of Competency.

Certificates of competency to be held by officers of foreign-going and home-trade ships and foreign passenger ships.

11. (1) Every [foreign-going ship][1] and every [home-trade ship][1] of three hundred tons or upwards when going to sea from any place in the Union of Burma shall be provided with officers duly certificated under this Act according to the following scale, namely :—

(a) in any case, with a duly certificated master ;

(b) if the ship is of three hundred tons or upwards, with at least one officer besides the master holding a certificate not lower than that of a mate.

(2) Every [foreign-going steam-ship][1] when going to sea from any place in the Union of Burma shall be provided with engineers duly certificated under this Act according to the following scale, namely :—

(a) if the ship is of one hundred nominal horse-power or upwards, with at least two engineers, one of whom shall be a first class and the other a first class or second class engineer duly certificated ;

[1] Substituted by the Union of Burma (Adaptation of Laws) Order, 1948.

(*b*) if the ship is of less than one hundred nominal horse-power, with at least one engineer who is a first class or second class engineer duly certificated.

(3) Every [home-trade steam-ship][1] when going to sea from any place in the Union of Burma, and every foreign steam-ship carrying passengers between places in the Union of Burma, shall be provided with engineers duly certificated according to the following scale, namely :—

(*a*) if the ship is of fifty nominal horse-power or upwards, with at least one engineer who is a first class or second class engineer duly certificated :

(*b*) if the ship is of less than fifty nominal horse-power, with at least one engineer who is a first class or second class engineer, or an engine driver duly certificated.

(4) Nothing in this section which relates to engineers or engine drivers shall apply to any steam-ship to which the provisions of the Inland Steam-vessels Act apply.

When officer deemed duly certificated.

12. An officer shall not be deemed to be duly certificated under this Act, unless he holds a certificate of a grade appropriate to his station in the ship or of a higher grade,

(*a*) granted in accordance with the Merchant Shipping Acts or any Act repealed thereby, or this Act or any Act repealed by the Indian Merchant Shipping Act, 1923 ; or India XXI, 1923.

(*b*) issued by a competent authority in any British possession, the certificates of which have been declared by Order in Council made under section 102 of the Merchant Shipping Act, 1894, to have the same force as if they were granted under that Act. 57 & 58 Vict. c. 6

Penalty for serving, etc., as a master, mate or engineer without a certificate.

13. Any person who,—

(*a*) having been engaged as one of the officers mentioned in section 11, goes to sea as such officer without being duly certificated, or

(*b*) employs a person as an officer in contravention of section 11, without ascertaining that the person so serving is duly certificated,

shall be liable for each such offence to a fine which may extend to five hundred rupees.

Grades of certificates of competency.

14. (*1*) Certificates of competency shall be granted in accordance with this Act for each of the following grades, namely :—

Master of foreign-going ship.
First mate of foreign-going ship.
Second mate of foreign-going ship.
Master of a home-trade ship.
Mate of a home-trade ship.

[1] Substituted by the Union of Burma (Adaptation of Laws) Order, 1948.

First class engineer.
Second class engineer.
Engine driver.

(2) A certificate of competency for a foreign-going ship shall be deemed to be of a higher grade than the corresponding certificate for a home-trade ship, and shall entitle the lawful holder thereof to go to sea in the corresponding grade in such last-mentioned ship: but no certificate for a home-trade ship shall entitle the holder to go to sea as master or mate of a foreign-going ship.

Examinations for certificates.

15. The President of the Union or a person duly authorized by the President of the Union in this behalf shall appoint persons for the purpose of examining the qualifications of persons desirous of obtaining certificates of competency under this Act.

Grant of certificates on passing examinations.

16. The President of the Union or such authorized person shall deliver to every applicant, who is duly reported by the examiners to have passed the examination satisfactorily and to have given satisfactory evidence of his sobriety, experience and ability and general good conduct on board ship, such a certificate of competency as the case requires:

Provided that the President of the Union may, in any case in which he has reason to believe that the report has been unduly made, require, before granting a certificate, a re-examination of the applicant or a further inquiry into his testimonials and character.

Certificates of service of naval officers.

17. (1) A person who has attained the rank of lieutenant in [the Burma Navy][1] [* * * *][2] shall be entitled to a certificate of service as the master of a foreign-going ship without examination.

(2) A person who has attained the rank of engineer or assistant engineer in [the Burma Navy][1] [* * * *][2] shall be entitled without examination, if an engineer, to a certificate of service as first class engineer, and, if an assistant engineer, to a certificate of service as second class engineer.

(3) A certificate of service shall differ in form from a certificate of competency, and shall contain the name and rank of the person to whom it is delivered, and the President of the Union shall deliver a certificate of service to any person who proves himself to be entitled thereto.

(4) The provisions of this Act (including the penal provisions) shall apply in the case of a certificate of service as they apply in the case of a certificate of competency.

Form of certificates.

18. Every certificate of competency granted under this Act shall be in the prescribed form and shall be made in duplicate, and one copy shall be delivered to the person entitled to the certificate, and the other shall be kept by the President of the Union and recorded in the prescribed manner.

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[1] Substituted by the Union of Burma (Adaptation of Laws) Order, 1948.
[2] Omitted *ibid.*

Record of order affecting certificates.

19. A note of all orders made for suspending, cancelling, altering or otherwise affecting any certificate of competency, in pursuance of the powers contained in this Act, shall be entered on the copy of the certificate kept by the President of the Union.

Loss of certificates.

20. Whenever a master, mate, engineer or engine driver proves to the satisfaction of the President of the Union that he has, without fault on his part, lost or been deprived of a certificate already granted to him under this Act the President of the Union shall cause a copy of the certificate, to which by the record kept in accordance with this Act he appears to be entitled, to be granted to him, and such copy shall have all the effect of the original.

Power to make rules as to grant of certificates of competency.

21. (*1*) The President of the Union may make rules [1] to regulate the granting of certificates of competency under this Act, and may, by such rules,—

(*a*) provide for the conduct of the examination of persons desirous of obtaining certificates of competency as masters, mates, engineers or engine drivers;

(*b*) prescribe the qualifications to be respectively required of persons desirous of obtaining certificates of competency as masters, first mates, second mates, first class engineers, second class engineers or engine drivers;

(*c*) fix the fees to be paid by applicants for examination; and

(*d*) prescribe the form in which such certificates are to be framed and the manner in which the copy of the certificate to be kept by the President of the Union is to be recorded.

Production of certificates of competency to shipping-master.

22. (*1*) The master of a foreign-going ship—

(*a*) on signing the agreement with his crew shall produce to the shipping-master, before whom the same is signed, the certificates of competency which the master, mate and engineers of the ship are by this Act required to hold; and

(*b*) in the case of a running agreement shall also, before the second and every subsequent voyage, produce to the shipping-master the certificate of competency of any mate or engineer then first engaged by him who is required by this Act to hold a certificate.

(*2*) The master or owner of every home-trade ship of more than three hundred tons burden shall produce to some shipping-master in the Union of Burma, within twenty-one days after the thirtieth of June and the thirty-first of December in every year, or (if the ship is not at any port in the Union of Burma within twenty-one days after either the thirtieth of June or the thirty-first day of December in any year) within forty-eight hours after her next

[1] For such rules see *Burma Gazette*, 1952, Part I, page 1092.

BIBLIOGRAPHY

1. Burma Merchant Shipping Act, 1923.
2. International Conference on Training and Certification of Seafarers, 1978, IMO.
3. Transactions of Institute of Marine Engineers, Volumes 96 and 99.
4. Lectures on Maritime Safety Administration by Professor P.S.Vanchiswar, 1989.
5. Lectures on Maritime Education and Training by Captain D.M.Waters, 1989.
6. Papers of Fifth International Conference on Maritime Education and Training, 1988.
7. Lectures on the Legal Framework of the IMO by Dr.Thomas Mensah, 1989.
8. Worldmark Encylopedia of the Nations Volume 4, Asia and Oceania, Worldmark Press Ltd, 1984.
9. Atlas of South East Asia by Richard Ulack. Gyula Paur, Macmillan Publishing Company, New York, 1989.
10. Catalogs of the United States of America Merchant Marine Academy, King's Point, 1989.
11. Notification Number 166 - Rules relating to the Examinations of Second Class Engineers' Certificate of Competency, 1968.
12. Notification Number 173 - Rules relating to the Examinations of First Class Engineers' Certificate of Competency, 1970.
13. Document for Guidance, 1985, IMO.
14. Lectures on the United Nations System by B. Zagorin, 1989.
15. Harmonisation of Training Courses to National Certificate Structure, Paper sumitted to Seminar on Training, Certification and Examination of Marine Personnel, Malaysia, 1986, by U Sein Mg (Myanmar).