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## Comparative study of navigation syllabi for master mariners in maritime academies of different countries

Mahmood Ali Yousuf  
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WORLD MARITIME UNIVERSITY  
MALMÖ, SWEDEN

A COMPARATIVE STUDY OF NAVIGATION SYLLABI FOR MASTER MARINERS  
IN MARITIME ACADEMIES OF DIFFERENT COUNTRIES

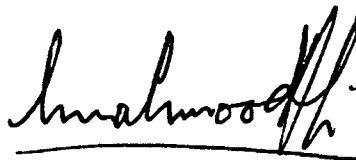
by  
Mahmood Ali Yousuf  
Pakistan

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  
MARITIME EDUCATION AND TRAINING (NAUTICAL).

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

Signature:



Date: 18 October 1988

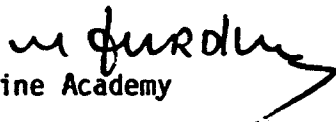
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By The Name Of The Beneficent, Merciful God

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Gunter Zade and other the Professors, visiting Professors, University staff and some of the IMLA conference members who provided me with information on "Navigation Syllabi" for Master Mariners in different countries.

Last but not the least my wife and children who endured hardships at home due to my inattention to them during these two years of studies at the University.

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## CHAPTER 1



## CHAPTER 1

1

### INTRODUCTION

#### 1.1 AIM OF THE PROJECT:

Navigation Syllabus is meant to train a navigator so that the objective of navigation may be met, which is: "To sail a craft (ship) from one port to another across oceans safely and economically". The factors hindering in achieving this objective of marine navigation is usually a mishap (an accident) at sea, resulting directly from the competent or incompetent failure of a navigator, known as a navigational error which forms a major part of human error.

1

A glance at the Lloyd's casualty return statistics or statistics from any other source for any year will confirm that how correct Mr.C.P. Srivastava, Secretary General of IMO was, when he said on the occasion of adopting the STCW convention in 1978 that, "It has been recognised that over 80 % of the marine accidents are caused by human error and the deck department must accept a fair share of this responsibility". The figures quoted in these sources and Mr.C.P.Srivastava do not include accidents to vessels under 200 GRT and thousands and thousands of uneventful accidents to crafts. Statistics indicate that the maximum of these casualties comprise of collisions and wrecked /stranded casualty figures which if attributed to human error, directly fall into the navigational

errors category because collisions and groundings relate to navigation and manoeuvring of vessels in a waterway. The accident occurs within a navigation system which consists of three basic elements: the vessel, the waterway and the navigator. Among other causes it may occur due to some built-in fault in the ship's bridge design or due to negligence or mis-judgement and wrong interpretation of the information extracted from an equipment. The former is very rare but latter is very common. In any way it reflects the poor knowledge of the navigator about the navigation equipment and its limitations. Therefore it can be concluded that the weak link in the marine navigation chain is, lack of properly trained personnel on the bridges of merchant ships. It is when this link breaks, black tide flows in upon the long coastlines and commodities worth millions of dollars sink down in the deep oceans. An insight into the details of navigation syllabi may indicate some deficiency.

2               Ships trading internationally navigate in all parts of the world under various conditions of navigational hazards. The navigators and the master mariners on these ships need to be taught a real good navigation syllabus to ensure safer and more efficient shipping by minimising the marine casualties due to navigational errors.

              Therefore the aim of the project is "To compare the navigation syllabi for the certificate of competency as master mariners (unlimited) of different countries" to highlight the similarities and differences in order to learn from each other.

## 1.2 DEFINITION OF THE TERMS:

### 1.2.1 Marine Navigation:

Process of taking a ship as safely, quickly and economically as possible from one place to another.

### 1.2.2 Navigation Syllabus:

A detailed course of study in navigation to acquire sufficient knowledge and practice to navigate vessels under any conditions.

### 1.2.3 Navigational Aid:

A ship board instrument, device, method or such, intended to assist in the navigation of a craft.

### 1.2.4 Aid to Navigation:

A device external to a craft which assists navigation.

### 1.2.5 Simulator:

A computer or other piece of equipment that can produce an effect of a desired system or condition and shows the effects of various applied changes.

### 1.2.6 Time Unit or Lecture hour:

Time Period equal to 60 minutes.

### 1.2.7 Retraining :

Upgrading or updating of knowledge in the same field for the sake of promotions.

1.2.8 All Countries:

The selected countries whose navigation syllabi have been chosen for a comparative study.

1.2.9 IMO figures or IMO's recommendations:

They refer to recommended teaching hours by the "detailed Teaching syllabus, Framework of Model Courses and specimen Examination Papers based on the 1978 STCW convention and associated 1978 STCW Conference Resolutions" Handout "A"(Incomplete) first draft 6th October 1980 by IMO Technical Co-operation project

1.2.10 MET:

Maritime Education and Training.

1.3 SCOPE OF THE STUDY:

The study is limited to the safety aspect of Marine Navigation syllabus for the certificate of competency as master mariner (unlimited) of the following selected countries.

- i Argentina
- ii Australia
- iii Canada
- iv Italy
- v Japan
- vi Poland
- vii United Kingdom

Information used have been collected through a questionnaire which has been answered by some individual on behalf of the maritime education and training institution of the countries listed above. In some cases questionnaire was supplemented by interviews with the persons who had replied the questionnaire.(section 2.4).Therefore a touch of personal interpretations and experiences is bound to involve.Hence the figures shown in tables may not be very official and reflecting the country's view point.

#### 1.4 NAVIGATION:-

Navigation can be divided into the following four types, namely:-

- (i) Land Navigation
- (ii) Marine Navigation
- (iii) Air Navigation and
- (iv) Space Navigation

Here I shall talk about Marine Navigation only, as Land, Air and Space Navigation is beyond scope.

#### 1.5 WHAT IS NAVIGATION ?

The word navigation has been derived from the Latin and is a combination of *navis*, a ship and *agere*, to drive.

Navigation therefore originally meant, "ship driving", which included steering and setting sails.

Whatever the original word or language was, the expression (navigation) originated from the animal instinct.

That is to say that when an animal on land, in air or in water moves from one place to another, it always has a definite purpose which may range from hunting to avoiding danger to its life. Whatever the case may be, on all occasions remaining in the normal working mode, it needs:

- i To sense direction of the object of interest, with respect to its own position or vice-versa -----Homing instinct.
- ii To have a complete control over its motion

- (i.e a capability to accelerate/ decelerate to stop and to turn)to keep timing with the movements of the object of interest which may be a prey or a hunter.----- Timing instinct.
- iii Sufficient energy to expend to achieve the objective.

For instance when animal having sufficient energy wants to hunt another animal, it goes through the following process.

- i It estimates the initial position, course and speed of the prey and
- ii It calculates its own course and speed for a appropriate rendezvous taking into account the prevailing circumstances or environment.

Having made the above calculations it sets off on the planned course with the planned speed. When it notices any change in the movements of the prey or any hindrance in its own way, it re-adjusts its course and speed accordingly. This process continues till a rendezvous occurs or the hunter runs out of energy. This necessitates to conserve energy specially if a long chase is expected.

In the same way, a marine craft called a vessel, wishing to navigate from one place to another should have the following capabilities.

- i It should have some motive power to produce a stabilized motion like an animal.
- ii It should have means to control its motion (i.e acceleration/deceleration and turning capability).
- iii It should have means to find direction.

Having above said capabilities, a vessel can be compared to an animal and the definition of navigation can be concluded by quoting E.W. Anderson (Animals as Navigators) , "Purposeful control of motion from place to place is called navigation". or it can be put in other words again by E.W. Anderson . Navigation is " Business of conducting a craft from place to place".(Principles of Navigation). "purposeful and controlled motion", is the essence of navigation .Hence a vessel drifting with current or wind, or spinning round and round like a top will hardly be considered navigating. Navigation indeed covers all phases of journey including departure and arrival. But

Strictly speaking at any stage of the voyage, safety, is not an expressed requirement but only an implied one, because a vessel reaching her destination even if in injured condition will have completed the act of navigation. Also in case of a war ship in war whose purpose is not safety but to sink or damage an enemy ship, can sink or get damaged itself in the process, yet it completes act of navigation because that was the purpose of her controlled motion. However for a merchant ship, fishing vessel or a pleasure craft , the purpose of navigation is to reach destination safely. Hence the basic definition may be modified as "Navigation is the business of conducting a craft from place to place safely". Still it does not fulfil the commercial purpose of a merchant ship's navigation which when included the definition will be: "Business of conducting a craft on her ways from one place to another safely and economically.



### Process of Navigation:

When a vessel proceeds from one port to another having sufficient power to complete the voyage, it needs to perform the following tasks to reach destination safely and economically.

- i To find the way or route to follow.
- ii To avoid collision with fixed or moving objects .

Finding of position is a pre-requisite to finding of way or a route to follow to reach destination. Similarly avoiding of collision needs a complete control over its motion, i.e a capability of accelerating/decelerating, stopping and turning. This process of controlling the ship's movements is called "Handling". The above mentioned tasks are performed in three stages.

The first stage is to decide the most appropriate route to the destination which has to do with the static positions and distances.

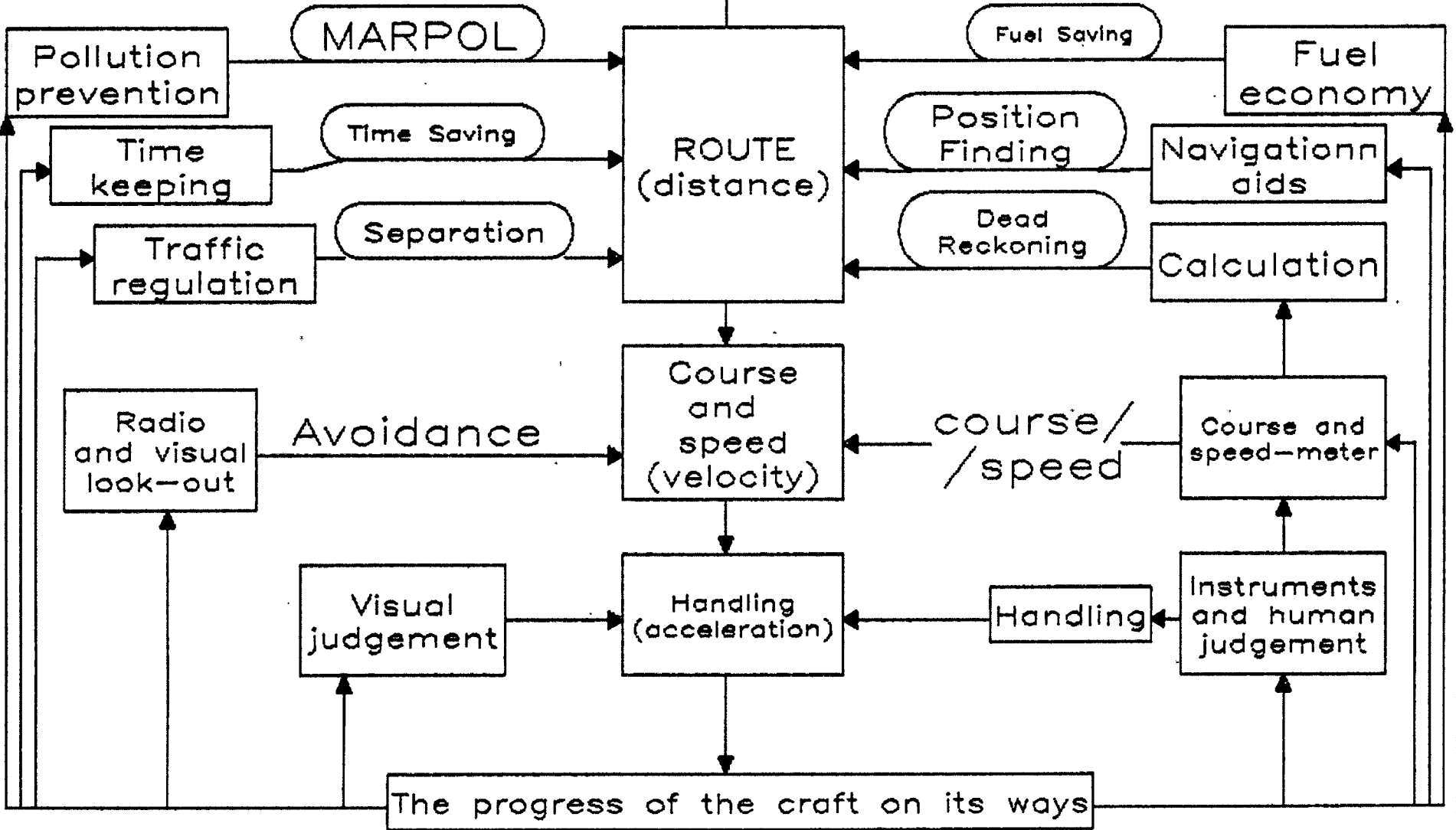
In the second stage, the chosen route needs to be traversed by steering the vessel on certain course and with certain speed. Third stage involves compensating disturbances of the stabilized velocity along the route (to avoid un-necessary wastage of fuel if the vessel is power driven). The process of navigation incorporating these stages is again, according to E.W. Anderson, "in the form of series of closed loops (See sketch on the next page) one inside the other like the skins of an onion". Inside the outer position finding loop there is an inner course and speed loop. The inner most "handling loop" is active all the times. Position is found relatively at longer

# FINDING WAY

Pollution Prevention  
Avoiding collision

Time keeping  
Fuel economy

NAVIGATION AIM



intervals either with some position fixing instrument or by using the technique of dead-reckoning. Course is checked with direction indicating instruments such as a compass at frequent intervals to ensure the traversing of planned route. Speed may be checked with the help of logs or by human judgement. With the increase in traffic, chances of collisions increased tremendously. Therefore to avoid collisions human judgement is required to avert a possible collision. Additional look-out is necessary to get early warning of the dangerous situations. This has to be taken care of all the time, which makes another inner loop parallel to handling loop. This may be called inner avoidance loop. In order to create a better understanding among different ships navigating in the same area, one way street principle may be adopted together with other guiding rules to avoid confusion in doubtful situations. Hence every vessel is required to follow traffic regulations which is now obligatory requirement. Therefore when pollution of marine environment increased due to spillage and deliberate discharge of cargoes dangerous to marine life directly and to human life indirectly. Then such a pollution had to be declared unlawful, which now has to be adhered to like adhering to the collision regulations by all vessels navigating in the oceans. Similar to traffic regulations, new pollution prevention rules also became necessary which have to be followed by every vessel at every place now to keep the marine environment clean for mutual benefits.

### **New dimensions of Navigation:**

So far navigation has been an art because there was a certain amount of knowledge and skill required to navigate a vessel which every body could not do, but with the introduction of "automation" and "computer technology", almost all judgements are made with reasonably accurate and reliable instruments contributing to proper decision making. Instruments work on the systematized general truths and laws. Art explained becomes science. All navigation loops are now automatically completed without human interference. The position finding loop is being completed with automatic position fixing instruments like "a Satellite Navigator". Course and speed loops by "Gyro compass" and "Doppler logs" and collision avoidance loops by instruments like "ARPA". The inner most handling loop is completed automatically by "Auto pilots etc. Instruments are there to warn the navigator and to check the pollution of marine environment. There is an instrument to perform every job on board which previously needed human capability.

Increased traffic density, larger ships with deep drafts and ships travelling at high speed, place heavy demands on accurate navigation. Thus computerized integrated bridge systems have therefore been developed to take the processing of data coming from various instruments and combining these data to provide continuously a meaningful and fully up to date presentation of situation for the navigator to analyse and make best decisions. Hence

the modern marine Navigation may be defined as "The science of conducting moving vessels along their ways as safely, quickly and economically as possible from one place to another keeping in view the cleanliness of the surrounding marine environment". Such a navigation has the following essentials:

- i Finding the way.
- ii Avoiding collisions.
- iii Fuel economy.
- iv Time keeping. and
- v Pollution prevention.

Thus the marine navigation has three aspects:

i **Safety aspect :**

This includes, "Finding the way" and "Avoiding collisions". Finding the way necessitates position finding and traversing appropriate route by keeping ship's motion controlled through handling. Avoiding collisions necessitates again a complete control over the motion of the vessel and adherence to the international regulations for preventing collisions at sea.

ii **Economic aspect.**

Consists of "Fuel economy" and "time keeping"

iii **Environmental aspect.**

This concerns with the keeping of seas and oceans clean to conserve the marine life and other associated industries for the mutual benefits of mankind.

## 1.6 MET SYSTEMS IN THE SELECTED COUNTRIES

A brief introduction to maritime education and training systems and the teaching of navigation in the countries whose navigation syllabi have been included for a comparative study is given below.

### 1.6.1 ARGENTINA.

MET in Argentina is relatively free from the military (Navy) control unlike most of the South American countries and is rated as higher technical education. National maritime Academy of Argentina established in 1799 is the oldest Academy if not in the entire American continent then at least in Latin America. The Academy was the first in Argentina to start teaching mathematics. Students are inducted at the age of about 17 years after 12 years of general education. They remain in the Academy for 4 years. During this period they go to sea for 14.5 months. At the end of this period they are awarded a certificate and not a degree or diploma like all other selected countries. This can get them admission in the 2nd year in a privately owned university of merchant marine for post graduate courses. Certificate of competency examinations are conducted by the Academy under the ministry of defence.

### 1.6.2 AUSTRALIA:

Australia has 3 institutions for the education and training of ship board officers. Two parallel schemes exist for the training of

prospective master mariners who may be awarded a certificate of competency as class 1 master (unlimited) .

i Company cadet training scheme:

Here the students are inducted after 10 years of general education at the age of around 17, duly sponsored by shipping companies. This scheme incorporates both watch keeper and master unlimited work and leads to Diploma of Applied Science in nautical science. Navigation is dealt with through a series of 5 discrete but inter-linked units spread over the four years. 18 months out of 4 years is spent at sea. In addition to class room teaching the knowledge and skills are further enhanced through a carefully interfaced programme on radar and ship simulators. 9 weeks are spent on a training vessel.

ii Certificate of competency as master class 1.

This is a traditional scheme where individuals serve at sea and after completing required sea time can go through various courses and examinations to end up at master mariner's certificate of competency (unlimited).

### 1.6.3 CANADA

There are six institutions where potential master mariners are trained in two parallel schemes. One the so called hawse pipe or front end traditional scheme ,where no limit has been set for basic general education and age. This is primarily a facility for the ratings to progress

and to rise to master mariner and higher levels. The other one is a Diploma Programme in nautical studies which also includes master mariner's (unlimited) work. Students after 12 years of general education at the age of 18 to 19 years are inducted into the programme where they undergo nautical education for 27 months at the school and 18 months industrial training on board sea going ships in 3 different installments. At the end of 4 years, students are awarded a Diploma in Nautical Science and a certificate of competency as First Mate in intermediate trade which is equivalent to a certificate of competency as 2nd Mate (unlimited) if one passes examinations conducted by the Coast Guards on behalf of Ministry of Transport.

#### 1.6.4 ITALY.

The Nautical Institute in Trieste inducts students at the age of 14 when they have only a secondary school certificate. Students remain in the Institute for 5 years. For the first two years they study only general education subjects and the last three years are devoted to specialization in one of the three branches, i.e.

- i Nautical Studies
- ii Marine Engineering
- iii Ship Building

Students of the Nautical branch, on graduation from the Institute, receive a "Diploma qualification for the command of a merchant



ship". Thereafter they have to serve on board a merchant ship for at least 18 months out of which at least 6 months should have been spent on deck as a cadet. Then at the age of 21 years one can apply to the government port authority for the examination for a certificate of competency as 3rd mate. At this stage the candidate should have obtained a radar observer certificate. After acquiring a certificate of competency as 3rd mate and 2nd mate and serving for another 30 months at sea, out of which 12 months as an independent watch keeper at the age of 24 one can qualify for the examination for a certificate of competency as 1st mate and master (unlimited).

#### 1.6.5 JAPAN.

After compulsory minimum 9 years of general education at the age of between 15 and 19 students are inducted into mercantile marine colleges and universities after passing an entrance examination which consists of a written examination and a medical check up. There are two mercantile marine universities and 5 mercantile marine colleges which in conjunction with an institute for sea training educate and train master mariners (unlimited) directly.

Apart from these institutions there are more than 70 more marine institutes whose graduates can end up with certificate of competency as master mariner (unlimited) subject to sea time requirement and passing of state examinations for this purpose. After graduating from the mercantile marine institutions, a student is required to undergo a

sea training course for six months at the institute for sea training, where he will be awarded a watch keeping certificate of competency. Subject to passing this and other forthcoming examinations he will be awarded a certificate of competency as master mariner.

Japanese are proud of their education and training system because various marine casualties statistics show that the total loss of Japanese ships between 1976 and 1980 was 0.12%. This numerical value includes loss of ships of more than 100 GRT, whereas in other countries it is more than 200 GRT. It is interesting to note that the natural conditions in Japanese waters are more severe to small ships of 100 GRT.

#### 1.6.6 POLAND:

After 12 years of general education at the minimum age of 17, a young man joins a merchant marine academy if he passes an entrance examination. Before starting education and training at the academy the entrants are acclimatised to sea through a six week cruise on a sailing vessel as probationary period. Merchant marine academy is a higher technical school at the academic level. The graduates are employed on board ships as well as in the maritime administration. At the academy studies last for 5 years and the graduates of navigation department receive B.Sc navigation degree. Instructions at the academy last for 3.5 years and the remaining 1.5 years are spent aboard training and merchant ships in several instalments of time. After the 4th year of

study , a 2 weeks radar course followed by an examination ,awards a student the Radar Observer Certificate. During the course of studies a student is also required to write a thesis on a professional subjects. The defending his thesis and passing of the final examination he is awarded B.Sc a degree in Navigation. Another six months of sea service as an assistant officer one obtains a certificate of competency as 3rd mate. To obtain a certificate of competency as master, an officer has to pass through two more stages. Attending upgrading courses and passing state examinations while having acquired 42 months more sea time, one obtains a certificate of competency as master mariner (unlimited).

#### 1.6.7 UNITED KINGDOM:

The country has 5 institutions where along with technical faculties there exists the provision of educating and training master mariners and other navigating officers. Medically suitable students after thier "O" level or "A" level i.e after 12 or 13 years of general education may be admitted. Training schemes for both entries are in the form of a sandwich with alternating periods in college and at sea. Both schemes ultimately lead to the award of National Diploma in Nautical science and to the achievement of the class 1 certificate of competency.

## CHAPTER 2

## CHAPTER 2

### METHODOLOGY

#### 2.1 METHODS CHOSEN TO COLLECT INFORMATION:-

To gather information from various parts of the world for my research work on "a comparative study of navigation syllabi for master mariners of different countries." I had to choose the option of correspondence with those countries. This was done in two stages.

In stage one I had to write letters to various renowned people in the subject of navigation in various maritime education and training institutions in twentytwo countries of the world.

The countries so selected had in one way or other some kind of prominence in the shipping world. In addition they represented various political and socio-economic systems, former and present colonial powers, colonies and independent from the former two types. Ten out of twenty-two countries replied positively by mail and from ten out of the remaining twelve I could extract information otherwise i.e I visited some of these institutions and collected the information and in the remaining cases some professors from those institutions visited World Maritime University and I collected some of the required information from them.

Nine of the navigation syllabi so collected were in a language other than English. I somehow managed to get some of them translated into English raising the total available syllabi in English to seventeen. Some of these translations came in at very late stage. On a thorough scrutiny of those in English revealed that at least six of them had insufficient information to be processed.

## 2.2 COUNTRIES CHOSEN INITIALLY:

Out of the remaining eleven countries eight were selected for a comparative study. These included ,

### 1 Australia:

Australia was chosen because of her unique position in the southern oceans and a detached land mass from the rest of the world .She has a prominent position in the shipping world . Once following the British system of education Australia now has a reasonably advanced and independent maritime education and training system.

### 2 NORWAY:

Being one of the Scandanavian countries she also is a member of NATO. Norway has the biggest merchant fleet in Scandanavia and one of the biggest in the world. Her position is noteworthy in ship building and allied electronics industry (NORCONTROL simulators). About 20 % of the population in Norway has professions connected with sea .She too has an independent maritime

education and training system.

3 France:

A developed west European country and a colonial power, France has a very high position in shipping circles and successfully operating deck-engine bivalent maritime education and training system which is now being followed by some others countries.

4 Japan:

Most developed far eastern nation, an economic super power having biggest multipurpose commercial shipping industry in the world, was chosen because of her unique position in the shipping world. Japan too has an independent maritime education and training system and successfully operating deck-engine bivalent training system.

5 Philippines:

Philippines was included in the list because she supplies crews to a lot of shipping companies operating world wide. Her crews are being accepted everywhere which include both officers and ratings.

6 Poland:

An east European country representing a different political and socio-economic system, only second to USSR in importance and having a fairly big merchant fleet. Poland also has a different maritime education and training system.

## 7 United Kingdom:

United Kingdom was selected to include in the list for being a very special country. She has been the biggest colonial power in the past and still is a colonial power. She is leading all Common Wealth countries. She has the privilege of being known as the mother of maritime institutions. She has a somewhat complex maritime education and training system.

## 8 United States Of America:

A super power having influence over almost all the world in all fields. USA also has a maritime education and training system suiting her needs. She still has not signed the 1978 STCW Convention.

## 9 Canada:

Canada was also requested for the information on navigation syllabus to be included in the comparative study if no answer was received from the United States of America. Because she could be compared to USA. Not really a big maritime country, Canada has the longest coastline (33,685 nautical miles) in the world. Her ships operate in the Great Lakes, Arctic and Atlantic oceans. There are 16,000 people employed in the home trade vessels and 45,000 in the fishing vessels navigating in the most severe ice conditions and uncharted coastal waters. This gives Canada a very unique position in the world. She has a maritime education and training system adopted to her needs which UK had some years ago.



In the second stage , After going through the navigation syllabi of these countries ,a questionnaire was prepared to get some more and specific information on navigation syllabi of these countries. This questionnaire was despatched to thirteen countries which included those eight whose navigation syllabi were already selected for comparison and those four whose navigation syllabi did not have sufficient information. Earlier the navigation syllabus from Japan was not received . It was requested once again not only to send her navigation syllabus but also respond to the information requested in the questionnaire . Unfortunately this time again only the questionnaire was received and not the navigation syllabus.

### 2.3 COUNTRIES SELECTED FINALLY:-

Out of thirteen , only seven questionnaires including that of Japan were received which were included in the list to conduct a comparative study . The questionnaires had been answered by some body on behalf of the following institutions and countries.

- 1 Argentina                      Escuela Nacional de Nautica.  
Av. Antartida Argentina 1535  
1104 Buenos Aires  
Argentina.
  
- 2 Australia.                      Australian Maritime College.  
P.O.Box 986 Launceston.  
Tasmania.

- Australia 7250.
- 3 Canada. Marine Institute.  
Newfoundland and Labrador  
Institute of Fisheries and  
Marine Technology.  
P.O.Box.4920.St.John's.  
Newfoundland,  
Canada A1C 5R3.
- 4 Italy Istituto Technico Nautico.  
Piazza Hortis 1  
Trieste.  
Italy.
- 5 Japan Kobe University of Mercantile  
Marine.  
1-1,5-chome,Fukae-Minami-Ma-  
chi.  
Higashinada-ku,Kobe 658.  
Japan.
- 6 Poland Merchant Marine Academy.  
Higher Merchant Marine  
Academy.Al-Zjednoczenia  
81345 - Gdynia,  
Poland.
- 7 United Kingdom College of Maritime Studies.  
Warsash,Southampton.  
SO3 6ZL, England.

#### 2.4 INTERVIEWS

The information collected through a

letter and questionnaire were supplemented by interviews with the following persons.

- 1 Mr. Federico Hatzenbuhlar  
Escuela Nacional de Nautica  
Argentina.
  
- 2 Mr. P. Muirhead  
Head school of navigation.  
Launceston - Tasmania  
Australia.
  
- 3 D. Drown  
Marine Institute  
Newfoundland  
Canada
  
- 4 Mr. P. Stenner  
Istituto Technico Nautico Statale  
Trieste  
Italy
  
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**CHAPTER 3**

## CHAPTER 3

### RESULTS AND DISCUSSIONS

#### 3.1 INTRODUCTION:-

Navigation syllabus for the certificate of competency as master mariners (unlimited) of a country depends upon many local circumstances such as socio-economic and political system, amount of trade and the role of shipping in the economy of the country, influence and economic pressures from the industry, historical background and climatic conditions. Therefore differences are expected to be there.

Presentation of the navigation syllabus of all the countries do not coincide with each other or with the 1978 STCW convention. Therefore the contents of navigation syllabus of any country can not be compared to each other.

Time spent by each country in teaching navigation in various ways has been compared to each other and where applicable to the recommended teaching hours figures of the IMO's Model Syllabus (Chapter 1). The said Model syllabus prepared by the IMO based on the STCW 1978 convention is still incomplete and upto the watch keeper level only.

Part of my definition of navigation (chapter 1) does not exactly coincide with the one presented by the IMO in the Model Syllabus, where "Ship handling" and "Collision Regulations" have

been shown under the heading of "Marine Transportation".and sub heading "Seamanship" and "Watch keeping". I have found out the time recommended for these headings proportionately and added it to the time allocated for navigation in this Model Syllabus. That way recommended total time for teaching navigation turns out to be 845 hours out of which 495 hours has been allocated to class room work and 350 hours to laboratory or practical works. In percentage it is 58.6 % and 41.4 % respectively.

13 arguments about navigation have been compared and conclusions drawn.

## 3.2 MARITIME EDUCATION TRAINING SYSTEM INFORMATION MATRIX:-

Requirements	Countries---->	Argen tina	Austr alia	Cana da	Italy	Japan	Pol and	UK
1	Total number of institutions to train master mariners.	1	3	6	38	7	2	5
2	Minimum age required to enter maritime training institution.	17	18	18	14	15-18	17	16
3	Necessary sea service prior entry maritime college.	no	no	no	no	no	6 weeks	no
4	Total shore time till master mariner certificate. (in months)	28 net	17 net	27 gross	60 gross	42 gross	42 gross	26 net
5	Controlled sea time (Training ship time). in months	14.5	18	12	none	12	18	15
6	Minimum sea time(uncontrolled) Prior to Master mariner certificate(months).	30	36	36	48	48	72	42
7	Written exam required before certificate of master mariner.	yes	yes	no	yes	yes	yes	yes
8	Oral examination required.	yes	yes	yes	yes	yes	yes	yes
9	Minimum percentage of marks. required to pass.	60%	70%	70%	no	60%	60%	65%
10	Minimum general education. required to be a master Mariner.(in years)	12	12	12	8	12	12	12
11	Is a Diploma or Degree issued on graduation from the college.	nil	yes	yes	yes	yes	yes	yes

Table 1

**STATUS OF SELECTED COUNTRIES TO IMO'S CONVENTIONS ON NAVIGATION**

Country---->		Argentina	Australia	Canada	Italy	Japan	Poland	UK
Conventions								
1	SOLAS 74	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Ammendment 78 to SOLAS 74	Yes	Yes	no	Yes	Yes	Yes	Yes
3	Col.Reg 72	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	STCW 78	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	MARPOL 73/78							
	Annex 1/2	No	No	No	Yes	Yes	Yes	Yes
	Annex 3	No	No	No	Yes	Yes	Yes	Yes
	Annex 4	No	No	No	Yes	Yes	Yes	No
	Annex 5	No	No	No	Yes	Yes	Yes	No



### 3.3 STATUS OF SELECTED COUNTRIES REGARDING IMO'S CONVENTIONS CONCERNING NAVIGATION AND PRESENTATION OF THE NAVIGATION SYLLABI

Table 1 indicates the status of the selected countries to the IMO's international conventions relating to navigation.

#### 1 SOLAS 1974 and Ammendments:-

The Safety of Life At Sea convention deals with all matters concerning with the construction and the navigation of ships. This has been ratified by all selected countries. However 1978 protocol has not been ratified by Canada but hopefully will be done soon.

#### 2 Col Reg 1972:

International convention on the Regulations for Preventing Collisions at Sea has been ratified by all selected countries.

#### 3 STCW 1978:-

Standards of Training ,Certification and Watch keeping convention indicates the minimum standards for the training of sea fares employed on board merchant ships in different capacities. The convention describes general requirements of such training and minimum curricula to be covered. It also specifies minimum sea time to be acquired before acquiring a certificate of competency as a watch keeper and master mariner and others for taking different positions on board merchant ships of various tonnages ,but it does not specify time

required to be spent in teaching navigation or any other subject individually or collectively. Certain requirements are there for upgrading and updating knowledge in various subjects including navigation. The convention has been adopted by all the selected countries. Therefore all selected countries cover minimum navigation syllabus designed for master mariners. Presentation of the navigation syllabus of any country is not in line with the presentation of the same by in the STCW 1978 convention.

4 MARPOL 73 / 78 :

Convention on preventing pollution of the Seas by oil and other chemicals carried by the ships also deals with the environmental aspect of navigation but not with the safety aspect. Therefore absence of its ratification by the selected countries does not effect the safety aspect of navigation syllabi. Argentina, Australia and Canada have not ratified but the remaining 4 countries have done.

### Conclutions

- 1 All the selected countries comply with the STCW 1978 convention. Therefore minimum syllabus requirement are met by all the countries.
- 2 Presentation of the navigation syllabi of the selected countries do not tally with the presentation given by the STCW convention or with each other.

Table 2

## TOTAL TIME SPENT ON TEACHING NAVIGATION

Name of the country --->	Argen tina	Austr alia	Can ada	Italy	Japan	Pol and	UK
Factor							
1 Total time spent on teaching navigation	728	1020	670	1126	1245	1126	-
2 Ratio of time spent on nav.to time spent on all subjects.	33.3%	36.6%	32.4%	22.3	54.2%	30.8%	-
3 Ratio of time spent on teaching nav.in the C/R to total.	45%	31.3%	84%	72%	23%	35.4%	-
4 Ratio of time spent on exercise to total navigation.	55%	68.7%	16%	28%	77%	64.6%	-
5 Percentage of marks required to pass certificate of competency written examination.	60%	70%	70%	No exams	60%	60%	50% 65%
6 Oral exam pass percentage required.	60%	P/F	90%	P/F	60%	60%	P/F

## Remarks:-

- i Teaching hours have been expressed in hours of 60 minutes.
- ii Exercise means experiments in the laboratory, assignments and practicals on board a training ship.
- iii P/F means Pass or Fail.

### 3.4 COMPARISON OF TOTAL TIME SPENT ON TEACHING NAVIGATION

The safety aspect of navigation includes as in Chapter 1 .

- (i) Finding the way
- (ii) Ship handling and
- (iii) Avoiding Collisions.

Table 2 shows the time spent on teaching navigation (safety aspect) which is the total of time spent in class rooms, laboratory and practicles or excercises including that at sea. It does not include the time spent at sea which is not controlled directly by the teaching institution .

- 1 Comparing these times one finds that exact similarity exists between Italy and Poland when comparing figures and the way in which these figures have been calculated.

In both the countries, time spent on navigation in the post sea courses have been included where as in the case of all other countries entire navigation syllabus is taught before the award of 1st certificate of competency. In the case of Poland 4 months and 5 months refresher courses are conducted in the Academy before the State examinations for the certificate of competency as 1st mate and master respectively. These courses are not mandatory but virtually every officer takes them. Now if one bifurcates the time spent on teaching navigation in the pre-sea and post sea levels then the figures are 928 and 198 hours respectively . In the case of Italy only two weeks radar and one week ARPA

courses are conducted in the post sea level. In terms of time units 1016 hours are spent in the pre-sea level and 110 hours in the post sea level. Other countries are in contrast to Poland and Italy and also to each other.

Average time spent on navigation for these selected countries excluding UK comes to be 986 hours which when compared to the time figures of countries individually, it is found that Argentina and Canada fall below and Australia, Italy, Poland and Japan above the average line. IMO's recommendations for teaching navigation (upto the watch keeper level only) which do not include teaching of ship handling are 730 hours. When looking at the contents of navigation syllabus of each country, it is found that Italy has much broader syllabus than others. In other words the navigation theoretical knowledge imparted to Italian students is much more than the students in other countries receive.

Australia ranks next higher. Her syllabus reveals that the topics in navigation which have importance in practical navigation are covered in detail. Australia and Poland also include new developments in navigation regularly in their navigation syllabi. The navigation syllabus taught in Japan seems to be a little compact when compared to Australia's and Poland's. Canada and Argentina on the other hand have allocated time to teach navigation which is less than all the countries even less than the IMO's recommended time units figure. Moreover the contents of its navigation syllabus seems to be just enough for the watch keeper level and not the master mariner level.

Hours spent on teaching navigation in United Kingdom are not available because UK does not allocate specific number of hours for any subject, instead it depends upon the teacher's discretion entirely who may take any amount of time he thinks appropriate.

- 2 Coming to percentage of time spent on navigation as compared to the total time spent on all the subjects taught to a prospective master mariner in these institutions, one finds again no exact similarity between any two countries. Figures for all these countries whose data is available range from 22.3% to 54.2%. Japan is the highest followed by Australia and Argentina. Italy is the lowest despite her position next to Japan in the former argument. Analysing the whole situation one can explain the differences easily. Referring to the matrix of other relevant information on these countries (section 3.2) will reveal that Japan which ranks highest teaches mostly nautical subjects during the final two years of studies along with English, German and French languages. She devotes more time to navigation practicals i.e on simulators and training vessels than any other country. In Australia, the net shore time for teaching theoretical subjects is only 17 months and if one adds controlled sea time also the total turns out to be only 35 months, in which only the nautical subjects are taught which are of practical consequence to a ship master. No general education subjects are taught not even English. That is why the ratio is higher in Australia than in other countries except Japan. Argentina teaches at least 4 general education subjects including English in addition to nautical subjects. Poland teaches even

more general education subjects in addition to English. But Italy inducts young students at the age of only 14 years, teaches them for 5 years (gross) in the school. The first two years are totally allocated to general education subjects which in the case of other countries are taught in the pre-maritime school period. Italy's total time amounts to more than 5000 hours. That is why its percentage of time spent on navigation comes so low despite having 1126 hours in teaching navigation.

- 3           When one compares the ratio of time spent in class rooms to the total time spent on teaching navigation it is found that Canada has the highest ratio and Japan the lowest. This is because Canada and Italy cover all syllabus in the class rooms and pays little attention to the practicals. What to talk of training ships Italy does not invest much time in exercises even, where as Japan covers little in class rooms but devotes a lot of time to exercises on the simulators and training ships : Even after graduating from the university all students have to go to Institute of Sea Training for six months for more practical exercises on training ships. Australia and Poland also have good facilities for practical training on simulators and training vessels . Argentina sends her students to a merchant ship belonging to the national company ,where the students are supervised by one of the instructors arranged by the Academy. Students on board ship work as required by the master of the ship appointed by the company.

- 4           Comparison of percentage of marks required to be obtained in the state examinations for the certificate of competency reveals similarity to a

great extent in almost all the countries except Italy and Canada. Canadian requirement is a little higher than all other countries where as Italy does not need written examinations at all. Oral examinations are also conducted in all the countries including Italy, who together with Australia and UK declare their candidates just pass or fail. All other countries except Canada require only 60 % marks to pass the examinations. Canada requires 90 % marks to pass in orals.

#### Conclusions:-

- 1 Japan spends less number of hours on teaching navigation in the class rooms and more on exercises on simulators and training ships , followed by Australia ,Poland and Argentina .
- 2 Canada spends more time in the class rooms and less on practice ,which is just the opposite of Japan.
- 3 Italy has much broader navigation syllabus (theoretical) than other selected countries.
- 4 Canada spends the least time in teaching navigation among the selected countries .
- 5 Looking at the contents Argentina's navigation syllabus appears to be the shallowest among the selected countries .
- 6 Japan has the highest and Italy the lowest ratio of time spent on teaching navigation to all other countries.



Table 3

## TIME SPENT ON TEACHING VARIOUS TOPICS IN NAVIGATION

(Time mentioned is in hours of 60 minutes)

Country ---->	Argen tina	Austr alia	Can ada	Italy	Japan	Pol and	UK
Topic							
1 Principles of navigation.	179	37.5	13.3	185	43.5	60	-
2 Coastal navigation	-	-	6.6	-	54.5	-	-
3 Pilotage	32	50	3.3	-	135	6	-
4 Chart Work	-	-	67	150	12	45	-
5 Terrestrial navigation	-	-	20	-	-	9.5	-
6 Tides & currents	21	-	13.3	15	24	48	-
7 Nautical Astronomy	-	62.5	10	-	-	24	-
8 Celestial Navigation	-	-	67	187	79.5	61.3	-
9 Spherical trigonometry	177	5	10	-	-	10.5	-
10 Practical navigation	-	-	20	-	-	45	-
11 Ocean & offshore navigation	-	-	7	-	15	-	-
12 Electronic Navigation	105	216.7	23.3	-	-	-	-
13 Electronoc Navigation systems	-	75	13.3	-	72	97.5	-
14 Nagigation aids	-	-	33.3	190	-	-	-
15 Aids to navigation	-	-	6.7	-	75	31.5	-
16 Navigation Instruments	-	-	40	-	-	12.8	-
17 Bridge instruments	-	116.7	6.7	-	177	73.5	-
18 Meteorological Instruments	-	-	10	136	-	18	-
19 Radio navigation	-	-	9.9	-	-	15	-
20 Satellite Navigation	-	-	6.6	22	-	9	-
21 Compasses							
Magnetic	-	25	20	22	-	21	-
Gyro	-	-	13.3	22	-	13.5	-
Total	534	588.4	420.6	929	620	601.5	-

## 3.5

## BREAKDOWN OF NAVIGATION SYLLABUS

Marine Navigation as defined in Chapter 1 has the following essentials.

- i Finding the way
- ii Avoiding collisions
- iii Economising on fuel
- iv Keeping time and
- v Protecting marine environment against pollution from ships(as required by MARPOL conventions)

After all these are part of ship's business on her ways at sea from one port to another which is called navigation ,but still most of the countries restrict the business of conducting a craft on her ways (Navigation) to "finding the way" only. If we concentrate on position finding only ,then position can be found in many ways and at various parts of the ocean .

Position finding or navigation with the help of shore or coastal objects in sight may be called Coastal Navigation or terrestrial navigation. some people may call it Pilotage .When position is found with the help of celestial bodies ,it may be called "celestial navigation" or "Astronomical Navigation",some people may also call it Ocean and off shore navigation too.In the same way there can be Radio navigation or Radar navigation , Electronic navigation and Satellite navigation etc . When we break down navigation into small headings like that and compare time spent in teaching each of these headings then Table 3 on the opposite page shows

total number of hours spent in class rooms , laboratory , and exercises or assignments for teaching various topics of navigation in different countries.

Some similarity exists among Canada ,Japan and Poland for breaking down navigation in small topics but when hours spent on teaching these topics are compared they are different.On the other hand in the same way some similarity is found among Australia ,Italy and Argentina in the way that they have not broken the navigation syllabus in so many small headings ,but they again are very different when time spent on these headings is compared .

All countries have allocated hours to teaching "Principles of Navigation" which for most countries mean the basics of all types of navigation techniques , they all vary greatly, Canada spends only 20 hours where as Italy allocates 185 hours for the same subject.Looking at their detailed syllabuses one finds only Italy having a topic named " navigation ,its principles,methods and aims." which is a very broad topic and Italy covers it in 185 hours. This figure is three times bigger than Polish and 8 times bigger than Canadian figure.If one compares these figures with IMO's recommended figures which is 110 hours for Principles of navigation and 90 hours for introduction to navigation (45 hours in class room and 45 hours in the laboratory) then all countries fall below except Italy and Argentina .Canada has divided navigation in four broad headings and perhaps covers basics of each topic when teaching that heading. Coming to Coastal Navigation which may be called as sum of Pilotage , Chartwork ,Terrestrial Navigation and Tides ,IMO

recommends 135 hours. Argentina ,Australia and Canada fall below that figure and Italy ,Japan and Poland are above .Japan has allocated 225.5 hours which is more than every other country because Japan has a very long coast line and her ships are mostly coasting .It is equally applicable to Italy ,Canada and Australia for the same reason ,but the time allocated for this by Canada and Australia is too less.In fact Canada should have much more time for this topic because maximum of her trade is coastal in great lakes ,Arctic and Atlantic Oceans.The total coastline is 33,685 nautical miles some of which is uncharted.

IMO recommends 125 hours to teach Ocean and Offshore Navigation which can be considered including "nautical astronomy , "celestial or astronomical navigation and "practical navigation". No similarity is found again between any two countries . Comparing with IMO's recommended time figures Australia , Canada and Japan are below the line and Poland Italy and Argentina above the line.

Comparing Electronic Navigation systems which include all electronic appliances used for navigatiogation ,one finds that all countries are above the IMO's recommended figures which is 90 hours.It may be noted that the hours recommended by IMO to teach various tpoics in navigation are only upto to the watch keeper level, where as most of the electronic navigation is in the Master's syllabus. That way Argentina and Canada are weak here too . When one compares the total number of hours spent on teaching these topics in navigation which are comparable to IMO's recommended topics , one finds that all countries whose data is available are below

the IMO's figures except Italy which is one and a half times that of IMO. All countries are almost on equal level with Japan and Poland closer to IMO than others. United Kingdom known as mother of shipping institutions does not go along these lines at all. - There exists credit hours system and time allocation to certain subject is totally dependent on the teacher. Therefore teaching hours have not been supplied by the UK.

#### Conclusions:-

- 1 All countries spend less time on teaching principles of navigation than IMO's recommended time except Italy and Argentina.
- 2 All countries spend more time on teaching coastal navigation than IMO recommends except Australia.
- 3 All countries spend more time on teaching electronic navigation systems than IMO recommends except Argentina.
- 4 In aggregate all countries spend less time on teaching navigation than what IMO recommends except Italy.

Table 4 a

HAVE THE FOLLOWING BEEN INCLUDED NAVIGATION ?

Country ---->	Argentina	Australia	Canada	Italy	Japan	Poland	U.K
Topic							
1 Passage planning	yes	yes	yes	yes	yes	yes	yes
2 Weather routing	does not teach at all	yes	no	no	yes	yes	yes
3 Ship handling or Ship manouvring	partly	yes	yes	no	yes	no	no
4 Collision Regulations	partly	yes	no	no	yes	no	no

Table 4 b

TIME SPENT ON TEACHING THESE TOPICS

(Hours mentioned are of 60 minutes)

Country---->	Argentina	Australia-Canada	Italy	Japan	Poland	U.K
Topic						
1 Passage planning	24	22.5	3.3	-	covered with other topics	64.5 -
2 Weather routing	-	5	2	16	75	-
3 Ship handling or Ship manouvring	84	15	10	272	94.5	112.5 -
4 Collision regulations	34.5	cannot estimate	20	-	67.5	86.3 -

3.6           **HAVE THE FOLLOWING BEEN INCLUDED IN  
                  NAVIGATION:-**

- i        Passage Planning
- ii       Weather Routing
- iii     Ship Handling or Ship Manoeuvring
- iv      Collision Regulations

1    **Passage Planning:**

          A Plan for the safe passing of a craft from point of departure to a point of arrival according to the prescribed criteria and given limitations. The main safety criteria for all crafts are grounding and collision avoidance. To draw such a plan before hand is not only a safety prerequisite but also a legal obligation vide IMO's Resolution NO.A-285-viii .

2    **Weather Routing:**

          Ship Weather Routing is a procedure whereby an optimum route is developed based on the forecast of weather and the ship characteristics for a particular transit. It is more of an economic than safety requirement but it definitely contributes to safety specially if too rough a weather is expected.

3    **Ship Handling:**

          Ship Handling is a process in which a ship's motion is controlled as necessary. It includes the understanding of the ship's characteristics

and behaviour under various conditions of environment .

#### 4 International Regulations for preventing Collision at Sea:

This is a international instrument for preventing collisions at sea between two or more vessels.

Referring to the current definition of Navigation which is "Navigation is the (art ?) science of conducting moving crafts from one place to another, safely, quickly and economically". Safety,time saving or time keeping and fuel economy all require a ship to follow the most direct but safe route to the destination."Passage Planning" and "Weather Routing" help us in achieving the above objectives i.e.safty,time saving and fuel economy.While traversing the planned safe and direct route,keeping ship's motion under control to avoid collisions with fixed and moving objects and the following of "Collision Regulations" specially in conjusted waters is an absolute necessity and legal obligation.After all navigation includes all phases of passage right from the berth at a departure port to a berth at arrival port. Controlling of ship's motion as necessary is called "Ship Handling or Manouvring" and the set principles to avoid collisions is knowns "Collision Regulations".Therefore Passage planning, Weather Routing , Ship Handling and Rules of the Road are all necessary parts of the process of Navigation.

Looking at the tables 4a and 4b on the opposite page reveal that,a similarity exists among all the countries when one talks of inclusion of



passage planning as required by IMO's Res.A-285.-viii in navigation. Inclusion of weather routing is common in Australia, Japan Poland and UK. Canada and Italy are in contrast. They teach weather routing but not as a part of navigation. Argentina is lacking behind by not teaching this topic at all. When it comes to inclusion of ship handling or ship manoeuvring in navigation. Similarity is found among Australia, Canada and Japan who say yes, and also among Italy, Poland and UK who say no. Argentina is somewhere in between because she includes it in navigation partly and partly teach this topic separately.

Australia and Japan are similar in including Collision Regulations in the navigation syllabus where as Canada, Italy, Poland and UK are similar in saying no to it. Argentina again partly includes them in navigation and remaining part teaches as a separate subject. This philosophy of Argentina is not understood. Italy teaches both of these subjects (ship handling and collision regulations) under the heading of "Safety on board" which necessarily is navigation when the ship is on her way to a port of departure at the high seas but not when she is at anchor. Australia and Japan agree with the agreement completely by including these subjects in navigation where as others agree partly.

Now looking at the second table (4b) which gives time spent on these topics. One finds no similarity among these countries at all. As has been stated above, majority of the navigational accidents have been found among other factors to be caused by either no or bad passage planning. The

importance of this, along with other topics is evident from the IMO Res.A-285-viii .Among the countries whose data is available,Poland allocates sufficient time for the passage planning. Astralia spends 22.5 hours conducting passage planning excercises on ship simulator . Canada whose navigation syllabus lays considerable importance on passage planning ,spends only 3.3 hours which obviously is very insufficient and reflects its poor interest in the safety of navigation which is for more important for Canada,because she has very long coast line not fully charted even and her home trade vessels are operating under svere weather conditions .She may improve upon this because she has recently ratified STCW Convention.Argentina spends 24 hours on passage planning but only on the theoretical part of it. Japan covers this and weather routing with other subjects in navigation presumably with ship handling and collision avoidance on the simulators which makes real sense.

Weather Routing covers less safety and more economic aspect of navigation.Thus countries who allocate more time to this topic seem to be caring enough for the economic aspect of navigation as well.Among the countries whose data is available there is too big a contrast.Time spent by Australia seems to be justified where as time spent by Poland is too much and Canada too less.

A thorough understanding of ship manoeuvring and practice contributes a lot to safety and economy of conducting ship's business. When one compares,time spent on this topic,no simi-

larity is found again. Australia spends 15 hours but on simulators, which gives good experience to the navigators. Canada spends too insufficient time on this topic too, though considerable mention is found in her navigation syllabus. Italy is as usual spending a lot of time but only on theory, nothing in laboratory which again is unreasonable. Japan spends considerable amount of time on board training ships to teach all these topics in their real sense. Poland also spends a lot of time on board training ships, 30 hours on lake manoeuvring model and 22.5 hours on simulators

Time spent on collision regulations also varies greatly. Canada spends only 20 hours, which is obviously too less. Japan spends 67.5 hours on board training ships and simulators teaching application of the rules in various traffic situations. Poland also spends enough time on merchant ships and in the class rooms. It may be mentioned here that IMO recommends 90 hours in class rooms only upto watch keeper level. That way all countries fall below that level. UK again covers this under the subject of Seamanship.

#### Conclusions:-

- 1 Passage planning and Weather routing are integral part of navigation.
- 2 Ship handling or ship manoeuvring is also considered part of navigation by most of the selected countries.
- 3 Collision regulations are not included in navigation by more countries though

according to widely accepted definition of navigation it is a necessary part of navigation.

- 4 Both ship handling and collision regulations are of practical consequence to ship masters, countries recognise this fact and lay emphasis on practical training in these subjects in the following descending order .

- 1 Japan
- 2 Poland
- 3 Australia
- 4 UK
- 5 Argentina
- 6 Canada
- 7 Italy

- 5 Theoretical education wise Italy spends more time on teaching navigation than any other country.

Table 5

## Updating Courses in Navigation

	Country	Is it mandatory	Course Name	Duration	Lecture Hours	Practice Hours
1	Argentina	no	Ship Manoeuvring	2 weeks	-	-
2	Australia	no	Radar Simulation	1 week	5.8	19.2
3	Canada	no	Navigation Instruments	2 months	-	26.7
		no	Electronic Navigation	2 months	-	46.7
		no	Ship Handling	4 weeks	-	6.7
4	Italy	yes	Radar Observer	2 weeks	40	40
		yes	ARPA	1 week	20	20
5	Japan	no	Advanced Course	2 years	360	-
		no	Special Course	1 year		-
		no	Short training course	4 months	358	-
		no	Correspondance courses		-	-
6	Poland	no	Refresher Course (for 1st Mates)	4 months	285	48
		no	Refresher Course (for Masters)	5 months	367.5	75
			Model on Lake manoeuvring course. (for commanding VLCCs over 120,000 tonnes ships)			
7	United Kingdom	no			-	-

### 3.7 UPGRADING COURSES IN NAVIGATION

Technological advancements in electronics and computer science have also brought changes in marine navigation techniques through new navigational devices like GPS and other integrated navigation systems, which have given new dimensions to marine navigation. Conservative and artful navigators who cannot keep themselves abreast of the innovations are scared of the scientific but accurate navigational gadgets. Many extremely useful information obtained from these devices are neglected in decision making merely because of navigator's inability to interpret them correctly. To bring these navigators in terms with these advancements is the need of the hour and updating courses in navigation is the answer.

Let us see what updating facilities or courses the selected countries have. Looking at them from this angle, one finds no similarity between any two countries except that no country has made such updating courses mandatory. Coming to actual courses as shown in table 5, they range from two weeks manoeuvring course in Argentina to several courses of up to 2 years duration in Japan. All the countries who have ratified STCW convention 1978 are obliged to conduct Radar Observer and ARPA courses before the award of certificates of Competency to master mariners and most of the countries comply with this legal minimum obligation during the shore based education and training phase before the award of 1st watch

keeping certificate of competency except Italy that does it in the post sea level. In fact these courses cannot be termed as upgrading courses at all, but part of basic training that is why no other country shows them as upgrading courses. All of these countries except Argentina are running diploma or degree programmes in nautical science. Australia, Canada, Japan, Poland and United Kingdom are also conducting retraining programmes parallel to diploma programmes to provide opportunities to the ratings and other less qualified personnel serving as navigators in different categories of trade and desirous of promotions to master mariners. These personnels need upgrading courses to update their navigational knowledge and to prepare for higher grade certificate examinations. Argentina, Australia and Canada, Japan, Poland and UK are conducting updating and refresher courses (which includes updating of navigation as well) to prepare navigators for the state examinations for higher certificates of competency.

Japan in this respect is having very special arrangements by establishing a marine technical college (which has three branches i 12-24, Nishikura-cho, Ashiya, Hyogo pref., 659 ii Kurashiki, Okayama pref., 711 Japan iii Nanao, Ishikawa pref., 926 Japan) which is totally devoted for the re-training of seafarers. Here updating courses are conducted to keep the ship's personnel abreast with innovations in nautical science as well as in the engineering knowledge. Advance courses of 2 years and special courses of one year cover humanities and nautical

subjects, where 1220 hrs and 603 hours respectively are spent on nautical subjects including 360 hours on navigation only. Short courses of six months (for junior officers) and four months (for senior officers) duration are conducted spending 42 hours per week only for updating nautical subjects which includes 358 hours for navigation. Apart from these correspondence courses are also conducted for those seamen who for different reasons cannot leave ships. In UK also Nautical Institutions arrange tailor made short courses to update knowledge in any subject including navigation on the request of maritime industries or anybody who pays for it.

**Conclusions:-**

- 1 No country has mandatory updating courses in navigation except those required by STCW convention 1978.
- 2 Japan pays more attention to retraining seafarers than any of the selected countries by establishing a marine technical college solely devoted to retraining.
- 3 Italy does not conduct any upgrading course in navigation except what is obligatory under the STCW 1978 convention.
- 4 Poland conducts apart from refresher courses, "manned model lake manoeuvring courses for the masters who are going to take command of VLCCs of more than 120,000 tonnes dead weight.



Table 6

## THE USE OF SIMULATORS TO TEACH NAVIGATION

(60 minutes hours spent on teaching navigation)

Countries ---->		Argen tina	Austr alia	Canada	Italy	Japan	Poland	UK
Simulators								
1	Radar Simulator	30	100	40	20	90	26	30 NCC *
2	ARPA Simulator	18.8	21.7	26.7	15	90	33	18 ENS *
3	Navigation Equip- ment Simulator	-	25	80	-	180	10.5	-
4	Manoeuvring simulator	-	-	-	-	-	22.5	-
	Or Bridge Simulator	-	-	13.3	-	-	-	30 ENS
	Or Ship Simulator	-	41.7	-	-	180	-	-
5	Lake Manoeuvring Manned Model	-	-	-	-	-	30	24
Total Hours		48.8	188.4	160	35	540	131.5	92

## Remarks:-

- i \* NCC stands for Navigation Control Course.
- ii \* ENS stands for Electronic Navigation Systems

Table 6a

## THE USE OF SIMULATORS TO TEACH NAVIGATION

At What stage of training these simulators are used

Countries ---->		Argen tina	Austr alia	Canada	Italy	Japan	Poland	UK
Training--->		year	year	year	year	year	year	during
Simulators								é
1	Radar Simulator	3rd	2nd/3rd	2nd	3rd/4th	3rd/4th	3rd	HND 2 é
2	ARPA Simulator	3rd	2nd/3rd	2nd	4th/5th	3rd/4th	3rd	HND 2 é
3	Navigation Equip- ment Simulator	-	3rd	4th	-	3rd/4th	5th	-
4	Manoeuvring simulator Or Bridge Simulator Or Ship Simulator	-	-	-	-	-	5th	- Company arrangement -
5	Lake Manoeuvring Manned Model	-	-	-	-	-	*	Special arrangements

Remarks:-

- i é HND stands for Higher National Diploma.
- ii \* Prior to command a VLCC of more than 120,000 tonnes Dead Weight.

### 3.8 USE OF SIMULATORS IN TEACHING NAVIGATION

Why to use simulators in training ?

A simulator can be an extremely useful tool in training master mariners for the following reasons.

- 1 A dangerous situation can be created and if necessary repeated to give the trainees full confidence in handling such a situation.
- 2 Any place or condition can be created in a training environment.
- 3 Parameters can be changed to the required condition.
- 4 Students can be trained economically and in short time.
- 5 Human performance under stress can be monitored

For these reasons the following simulators are used for teaching navigation in the training phase .

- 1 Radar navigation and Automatic Radar Plotting Aids (ARPA) Simulators:

As mentioned in chapter 1 highest number of marine casualties due to navigational errors are attributed to errors in human judgement. Therefore it is imperative that the human performance should be improved through training in navigation in different traffic and visibility situations. Lack or poor practical knowledge of

navigational equipment especially in Radar (compulsory navigational device on board every sea going ships) is a major source of such accidents. That is why Radar observer and ARPA training on simulators has been declared obligatory through the STCW convention 1978. A radar observer and ARPA course on a simulator is intended to reveal the equipment's capabilities and limitations to the observer or operator who is trained to interpret in the most accurate way the information extracted from the equipment. The equipment can be used as an anti collision as well as position finding device.

## 2 Navigational equipment simulator:

For safe and economical navigation it is important to know operation and limitations of the navigational equipment in use such as Decca ,Loran , Omega and satellite receivers together with other gadgets on the navigation bridge. This can be done on a shore based simulator incorporating all these instruments.

## 3 Manoeuvring and Ship or Bridge Simulators:

This type of simulator provides training facilities in ship handling using ship's characteristics and behaviour in various environment , but a ship or a bridge simulator does much more by performing all manoeuvres which are possible from the ship's bridge. This includes incorporation of navigational equipment and other instruments used for other purposes like communication etc. It affords training facilities

for almost all manoeuvres ranging from a simple alteration of course to berthing and unberthing manoeuvres and action following trouble due to equipment failure.

4 Lake manoeuvring manned model Simulator:-

This is a real model of ships operating in real lake or sea where actual behaviour of the ships can be experienced in real environment .

Coming to the real simulation facilities for the training of master mariners or navigators in the selected countries Table 6 indicates similarity in all the countries in the sense that all of them have Radar and ARPA simulators but when it comes to time spent on these simulators there is no similarity . Italy spends the least time in contrast to Japan where only Kobe University spends 90 hours on each simulator. Other countries fall in between the two. Under STCW convention 1978 , Master mariner's training on a radar and ARPA simulator is obligatory but there is no limit on time spent on such a training. IMO's model courses for watch keeper level (based on the STCW 1978 convention and associated resolutions) recommend 60 hours on practicals which include simulators or training vessel. Coming to navigation equipment simulator , Japan is well ahead of all other countries in spending time in training on this simulator too (180 hours). IMO recommends 70 hours only .Japan is followed by Canada , Australia ,UK and Poland.

When it comes to manoeuvring ,Bridge or ship simulator , Poland and Canada have only

manoeuvring simulators where as Japan,Australia and UK have ship or bridge simulators.No similarity is found again among these countries. Japan spends 120 hours in training navigators and master mariners on this simulator followed by Australia and Uk.UK uses it for research purposes and to train navigators who pay for it. UK and Poland additionally have lake manoeuvring manned model simulators which are used for research by UK and to train master mariners for taking command of VLCCs of more than 120,000 tonnes Dead Weight.

During what stage of training ashore exercises on the above simulators are conducted,is clear from table 6a.

### Conclusions

- 1 Japan uses simulators extensively in teaching navigation followed by Australia ,Canada , Poland and UK.
- 2 Australia spends more time than other countries in teaching radar navigation on simulator followed by Japan ,Canada ,UK, Argentina and Poland.
- 3 Italy spends the least time of all the selected countries in teaching navigation on simulators.
- 4 Poland and UK are the only countries which train master mariners on lake manoeuvring manned model simulatorss.
- 5 All selected countries teach navigation on simulators in the shore based training phase.

Table 7

## Laboratory equipment used to teach navigation

Country ----->	Argen tina	Austr alia	Canada	Italy	Japan	Poland	UK
Equipment							
-----							
1 Coastal Nav.							
Laboratory	yes	yes	yes	yes	yes	yes	yes
2 Radar Laboratory	yes	no	yes	no	no	yes	yes
3 Elect.Nav.Lab.							
(Real Instruments)							
Loran C	no	yes	yes	yes	yes	yes	yes
Decca Navigator	no	yes	yes	yes	yes	yes	yes
Omega	yes	yes	yes	yes	yes	yes	yes
Transit Sat.Nav.	no	yes	yes	yes	yes	yes	yes
R.D.Finder	yes	yes	yes	yes	yes	yes	yes
Echo Sounders	yes	yes	yes	yes	yes	yes	yes
Logs	yes	yes	yes	yes	yes	yes	yes
Gyro Compasses	yes	yes	yes	yes	yes	yes	yes
Magnetic Compass	yes	yes	yes	yes	yes	yes	yes
Auto Pilot Unit	yes	yes	yes	yes	yes	yes	yes
4 Computer Lab.	yes	yes	yes	yes	yes	yes	yes
5 Astro.Nav.Lab.							
Planetarium	no	no	yes	no	no	yes	no
Astro.Models	yes	yes	yes	yes	yes	yes	yes
Sextants	yes	yes	yes	yes	yes	yes	yes
Relevant Publi- cations	yes	yes	yes	yes	yes	yes	yes
6 Simulators	see table 6-----						
7 Training Vessels							
Sea going	yes	yes	yes	yes	yes	yes	yes
Boats	yes	yes	yes	yes	yes	yes	yes
-----							
Remarks.	i	Nav = Navigation		iv	Elect = Electronic		
	ii	Lab = Laboratory		v	R.D = Radio Direction		
	iii	Sat = Satellite					

### 3.9 LABORATORY EQUIPMENT USED TO TEACH NAVIGATION

Laboratory is a facility where experiments can be performed to prove certain facts. This needs equipment proper and relevant to the subject. Demonstrations in the laboratory as a back up of certain theoretical knowledge helps teachers to impart and students to grasp knowledge in its real sense. Hence laboratory equipment is a very effective teaching aid for the teachers and tool for the students to learn. Among a few more laboratory equipment is a measure of quality of an institution. The above is a fact which is true for any subject and for any institution.

Table 7 shows laboratory equipment used for teaching navigation in the selected countries, which when compared to each other is found as under.

#### 1 Coastal Navigation Laboratory :

Commonly known as chart room or chart work laboratory consisting of necessary furniture (chart tables and stools), instruments (parallel rulers, pair of compasses and dividers etc) and publications (real or practice charts, sailing directions, lists of lights, list of radio signals, notices to mariners and tide tables etc.) for the number of students in a class is found in every country. This is in line with IMO's recommendations. Therefore a complete similarity exists among all the selected countries.



## 2 Radar laboratory :-

IMO's model syllabus recommends that a radar laboratory should have a minimum one relative motion radar set, one true motion radar set and a reflection plotting facility together with other necessities in a radar laboratory. When the radar laboratories and equipment in them in the selected countries is compared to this standard radar laboratory, it is found that only Canada Poland and UK have real radar sets with desired facilities. Argentina, Australia and Italy instead have simulated facilities. Japan has a simulated radar laboratory but if it has real radar sets is not clear.

## 3 Electronic Navigation Aids Laboratory :-

Again IMO recommends the following instruments to include in such a laboratory. namely Decca Navigator MK 12 and MK 21, Loran C, Omega and Transit Satellite displays, radio direction finders, echo sounders, gyro compasses with repeaters, magnetic bearing compasses and gyro pilot units. When one compares the selected countries it is found that all of them have got real instruments but not exactly the models IMO has recommended. It is immaterial to talk of a specific model because the real requirement is to understand the principles and working of the instruments. IMO has recommended Decca Navigator model MK 12 and 21 because they are available in the market for hire, Again in the real sense all the selected countries are similar to IMO's recommendations and to each other when one talks of Electronic Navigation Aids Laboratory.

#### 4 Computer Laboratory :-

Computers are entering into every walk of life very fast. Navigation is no exception. The use of computers on board ships is now wide spread . Complex calculations including that of navigation can be done in seconds. Therefore to learn the proper use of computers is now essential . Therefore all the selected countries are similar to recognize the inevitable need of computer laboratories.

#### 5 Astronomical Navigation Laboratory:-

The laboratory should have equipment to demonstrate the movements of heavenly bodies used for navigation in relation to our Earth, so that the students may understand principles and their use in astronomical navigation . One such a device is a planetarium. Only Canada and Poland have this facility . Australia has a globe star projection system which is a near substitute for planetarium. The use of sextants and relevant publications is extremely important for astronomical navigation. All the countries have this simple facility. Therefore

Australia , Canada and Poland can be rated superior to others in Astronomical Navigation Laboratory equipment.

#### 6 Simulators:-

Simulators have already been discussed in section 3.8.

#### 7 Training Vessel:-

Training vessels can be of two types.

- 1 Sea going training vessel.

## 2 Small boats of various types.

Training vessel is the best aid for training navigators and master mariners in real environment but experience to limited to such a vessel only where as simulators can create any size and type of vessel and environment. Small boats are also necessary for practising navigation in sheltered waters.

Looking at the table it is found that all the selected countries are similar in having training vesels of both types.

### Conclusions

- 1 Similarity exists among all the selected countries and IMO's recommended syllabus when coastal navigation laboratory equipment is compared.
- 2 Canada ,Poland and UK have real radar sets in their radar laboratories but Argentina , Australia , Italy and Japan have simulated ones.
- 3 All countries have necessary models of real instruments for teaching electronic navigation systems.
- 4 All the selected countries have computer laboratories.
- 5 Australia ,Canada and Poland have better equipment than other countries in astronomical navigation laboratories.
- 6 All the selected countries have training vessels ,both sea going and small boats.

Table 8

## TEACHER STUDENT RATIO WHEN TEACHING NAVIGATION

Country --->		Argentina	Australia	Canada	Italy	Japan	Poland	UK
Place of teaching								
1	In Class rooms	1:20	1:60	1:15-30	1:20	1:60	1:25	1:20
2	In Laboratory	1:9	1:3-12	1:6	1:5-8	1:15	1:20	1:8
3	In Tutorials	-	1:20	1:6-12	-	1:30	1:11	1:12

## 3.10

## TEACHER STUDENT RATIO

Imparting of knowledge to students depends upon many conditions , among them the following two are important.

- 1 Mental level or capacity of the average student to acquire such knowledge.
- 2 Methodology of teaching and its effectiveness on the average student in the class.

Teacher student ratio has to do with these two factors. One teacher may communicate information effectively to a small group of students but the same information may not be passed effectively to a bigger group of same class of students under the same conditions. This means that the effectiveness of imparting knowledge to the students varies inversely with the number of students in the class.

Assuming the level of the students to be 12 years of general education which is the case with the prospective master mariners in almost all the countries, IMO (International Maritime Organization) consultants with vast experience in this field have recommended that the average teacher student ratio in the class room and in the laboratory should be 1:20 and between 1:6 and 1:8 respectively.

Table 8 shows the teacher student ratio in the selected countries ,one finds similarity among Argentina, Italy and the United Kingdom when teacher student ratio in class rooms is compared

which is incidently exactly in line with the IMO's recommendations .Also Australia and Japan are similar but in contrast when compared to IMO's recommended figures. Canada could be compared to Poland and to some extent to IMO's figures and other countries except Australia and Japan because her teacher student ratio in class room is 1:15 to 1:30 .

When one compares the ratio in laboratory , a near similarity may be established among Australia , Argentina ,Canada ,Italy and UK .They all can be compared to IMO's recommended figures. This time Japan and Poland are out but to some extent similar when compared to each other.

Comparing the tutorials or exercises figures, all countries are different.Near similarity may be found among Canada,Poland and UK.Argentina and Japan are far out from these contries as well from each other.IMO has not recommended any figure in this context.

#### Conclusions:-

- 1 Similarity is found among Argentina ,Canada , Italy, UK and to some extent Poland when compared to each other and to IMO's recommended figures in teacher Student ratio in class rooms.Also similarity exists between Australia and Japan when compared to each other.

- 2 Near similarity is found among Argentina , Australia ,Canada ,Italy and UK when compared to each other and to IMO's recommended figures in teacher student ratio in laboratory.
- 3 A near similarity exists among Canada ,Poland and UK when teacher student ratio in tutorials is compared.
- 4 Italy does not have teacher student teacher ratio in tutorials.

Table 9

## MORE ABOUT TEACHING NAVIGATION

Teaching method. Country--->	Argen tina	Austr alia	Canada	Italy	Japan	Pol and	UK
1 Sea orientation necessary before teaching navigation	no	no	no	yes	no	yes	no
2 Should the students be taken to ships for pratising nav.	yes	yes	yes	yes	yes	yes	yes
3 For how long do you take them to ships.	10 weeks	6 weeks	-	10 days	one year	14-18 weeks	not clear
4 Navigational exercises are solved by:							
Conventional nautical tables.	yes	yes	yes	yes	yes	yes	yes
Pocket calculator(programble)	yes	yes	yes	yes	no	yes	no
personal computers.	yes	yes	yes	yes	yes	yes	no.
5 Should the use of nautical tables be taught still despite modern computers.	yes	emphasis reduced.	yes	yes	yes	yes	yes
6 Has the role of navigation increased or decreased compared to a decade ago with in the total syllabus for master mariners.	incr'd	incr'd	same	dcr'd	incr'd	incr'd	incr'd

Remarks :- "incr'd" stands for Increased  
"dcr'd" stands for decreased



### 3.11 EFFECTIVE TEACHING OF NAVIGATION

The whole idea to teach navigation to prospective master mariners is to turn out better navigators who should clearly understand every thing about navigation and make correct decisions in all situations ,avoiding accidents due to navigational errors. In addition to effective teaching of navigation through better teaching aids and less teacher student ratio ,it is important that the student's aptitude and adoptability to sea should be tested.Also the right amount of knowledge in navigation should be imparted.

Table 10 gives some indication as to how different countries see this aspect of teaching navigation.

- 1 Five out of seven countries do not think that such sea orientation is necessary.Italy and Poland are of the view that such orientation is necessary. Italy acquaints its young students to sea for 10 days and Poland for 3 months on ships before teaching navigation.Logically it makes sense that the students should have real feeling of the atmosphere in which they are chosing to stay for a considerable length of time.If they like, they will be motivated to learn navigation more enthusiatically, and if they don,t, they will quit bringing the number of uninterested navigators down and lowering the rate of accidents due to navigational errors.
  
- 2 All countries agree that the students should be made to sail on board sea going ships ,where they

should see the actual lay out and operation of navigation aids and equipment and carry out exercises. For such exercises Canada does not take them to sea at all, though she has a training vessel 120 feet in length. Italy takes them to sea only for 10 days which infact is sea orientation. Poland takes them to sea for about 4 months. Apart from this all countries send their students to sea for about a year where the students are supervised indirectly by the institution.

- 3 When navigating especially in proximity of danger, it is extremely important to fix the vessel's position frequently with utmost accuracy. It becomes even more serious when shore aids to navigation are scarce and the option is only astronomical navigation. Calculations of astronomical position lines is a lengthy and time consuming process. Minutes count. Master wants position as quickly as possible. Here traditional methods of calculating line of position are frusterating. Programmable calculators and personal computers is the answer. Navigators can make clerickal mistakes ,computers wouldn,t. Therefore it is imperative to teach the students the use of such aids ,which do not make mistake and save time, thus giving a navigator more time and confidence to decide correctly. Looking at the selected countries from this angle it is found that all countries teach the use of nautical tables. All countries except Japan and UK teach the use of programmable calculators. Personal computers are taught in all the countries except UK.

### Conclusions

- 1 Sea orientation is not considered necessary before teaching navigation and inducting the students into MET institutions.
- 2 Practical exercises on board sea going ships is considered necessary for the effective teaching of navigation.
- 3 All the selected countries teach the use of nautical tables when teaching navigation.
- 4 All countries except Japan and UK teach the use of programmable calculators when teaching navigation.
- 5 All countries except UK teach the use of personal computers for navigational purposes.
- 6 The teaching of conventional nautical tables should be continued but with reduced emphasis.

Table 10

-----  
**UPDATING OF NAVIGATION SYLLABUS**  
 -----

Country	Do you update Nav.syllabus	How often	What changes have been made in the last decade
1 Argentina	yes	every two years	Subjects added and updated, like Passage planning, Electronic nav Radar nav. VTS, search and rescue.
2 Australia	yes	annually	Principles of nav .severely primed remains incorporated in coastal nav. Command nav. introduced at master level covering broader con- cepts of master's role in decision making and passage plan.
3 Canada	yes	4 yearly	More electronic nav. has been included.
4 Italy	yes	yearly	Changes as required.
5 Japan	yes	4-5 years	Duel watch system adopted.
6 Poland	yes	5 yearly	Some updating in electronic nav. according to IMO's recommendations
7 UK	yes	.5 yearly	Courses overall restructured.

-----

### 3.12 Changes took place in the last decade

With the passage of time, requirements of design and size of ships has been changing and so is the navigation pattern. In the past small and slow moving ships totally dependent on the wind direction and strength have now been replaced with mammoth deep draft and fast moving tankers and container ships. They have brought with them the requirement for precession, fuel economy and time keeping because now the ships are part of multi model transport system. To keep in line with innovations, navigation syllabus needs to cater such changes. The 1978 STCW convention has also played a vital role in uniforming and standardising the navigation syllabus and training system of sea fares. Table 10 indicates, what changes the selected countries have effected in navigation syllabus during the last decade. All countries have introduced changes into navigation syllabus to comply with the STCW 1978 convention. Those countries who had not included electronic navigation in their syllabus before, have done it during the last decade and the others have introduced more electronic navigation.

#### Conclusions

- 1 During the last decade navigation syllabus has been uniformed and brought in line with the STCW 1978 convention, also pressure by the industry has resulted in

introducing electronic navigation. At the same time emphasis on the conventional navigation methods has been reduce .

Table 12

## ANTICIPATED FUTURE CHANGES

Country	Changes
1 Argentina	More subjects about electronic navigation will have to be introduced. Satellite navigation will have to be taught. - Some electronic navigation system like Omega will vanish. Emphasis will be reduced greatly on astronomy and celestial navigation.
2 Australia	Greater emphasis on electronic navigation and on decision making process based upon an evaluation of data presentation from a one man bridge operation. The influence of traffic management and communication upon the navigation role. Introduction of ECDIS and global satellite communication system and computerized route planning.
3 Canada	A gradual increase in the introduction of electronic instruments, such as ECDIS. It is difficult to say if other aspect of navigation will become redundant and which navigation method will be used as a back up to the primary method of navigation. If Gyro has not been able to replace magnetic compass so far then we ask, can or will GPS or some other satellite navigation system replace completely some of the more traditional methods of navigation.
4 Italy	Navigation will reduce to its essentials in numerical work and will develop itself in the direction of a proper use and comprehension of modern instruments and their operation. - Manoeuvring of ships and ship stability etc will become subject of then navigation.
5 Japan	We need to shift the weight of contents of syllabuses on navigation from technical aspect to technological aspect such as from celestial navigation to "artificial satellite navigation", from pilotage to control engineering. The uniqueness of sea navigation will decrease. We need general approach to navigation by enhancing such fields as information processing, communication and control theory on navigation.
6 Poland	Increase ability of computers and electronic equipment operations.
7 UK	GPS may cause the demise of Decca, Loran and Omega and GMDSS of R.D.F as a statutory instrument. This leaves GPS, echosounder and radar the only position fixing instruments and astronomical navigation as a mere back up. As gyros become even more reliable and cheap the magnetic compass may disappear.

### 3.13 Anticipated changes in the Navigation syllabus

From the very beginning till now ,ships and shipping have undergone numerous changes . The process is still on and will continue in future too , and so will be the navigation syllabus. When the selected countries were asked about anticipated changes in navigation syllabus in future ,the answers appeared as in table 12. When one analyses the answers , a complete similarity is found in views of all the countries when they talk of introduction of more electronic navigation in future. This includes the anticipated "Global Positioning System" by launching artificial satellites in the space which will have to replace something ,because the amount of time available for teaching if not increased will force the teaching of some other navigation method(s) out . What navigation method is forced out,remains to be seen. Argentina is of the view that "omega" will be forced out and emphasis on "astronomy" and celestial navigation will be reduced where as Japan anticipates the shifting of weight of navigation syllabus contents from technical to technological aspects, such as from celestial navigation to satellite navigation and from pilotage to control engineering etc. Also a general approach to navigation will be needed by enhancing such fields as information process, communication and control theory on navigation .Australia thinks almost in line with Japan by anticipating greater emphasis on proper decision making process based



upon the evaluation of data presentation from a one man bridge operation. Such a bridge will present data from electronic charts ,traffic management facilities, global communication system and computerized route planning. Poland expects the increased role of computers and electronic equipment operations. Canada like others expects general increase in introduction of electronic instruments, but does not believe the ousting of conventional navigation methods. UK thinks that in future GPS(Global Positioning System) may replace Decca ,Loran ,Omega and GMDSS (Global Maritime Distress Safety Signal) statutory R.D.F(Radio Direction Finder). Gyro compass probably will replace conventional magnetic compass. Ultimately only GPS,echo sounder and radar will be left as position finding instruments.

It is true that technology is advancing with a tremendous speed. Electronic navigation system including radar, made a navigator's life on board easier by saving him a lot of time and trouble in navigating his ship with the tedious conventional navigation methods, but he was never comfortable because of limitations of these electronic gadgets. He always needed a back up system such as "dead reckoning " and "astronomical navigation. Gyro compass reasonably reliable has been in existence for some decades now but it always had to be compared with the standard compass in every watch at sea. The same is likely to remain valid in future also. GPS may cause the demise of Decca ,Loran and Omega but never the dead reckoning technique , astronomical navigation and position finding by

visual bearings. They will remain for ever as back up system. Electronic Navigation Systems however reliable they may be are dependent on electric power which if fails will bring every thing to stand still. Then only the back up will be helpful. Therefore the teaching of very basic navigation techniques should not be sacrificed at any cost at any time.

### Conclusions

- 1 More electronic navigation systems such as GPS ,GMDSS ,Electronic Navigation Chart and Global communication systems are anticipated to be introduced in future.
- 2 Emphasis on the conventional navigation methods will be reduced.
- 3 Greater emphasis will be placed on correct decision making based on data presentation in a one man bridge operation.
- 4 Computers will be involved more in navigation data processing than they are today.

**CHAPTER 4**

## CHAPTER 4

### CONCLUSIONS AND RECOMMENDATIONS

From the comparison of various arguments about navigation syllabus for the certificate of competency as master mariners (unlimited) in chapter 3 the following conclusions may be drawn.

#### 4.1 Similarities

- 1 All the selected countries have ratified the IMO's Conventions about the safety of navigation i.e. SOLAS 74. COL.REG.72 .and the STCW 1978.
- 2 All the countries teach entire navigation syllabus in the shore based training phase before the award of first certificate of competency except UK which covers it before the award of 2nd certificate of competency.
- 3 All the selected countries have dual training programmes for the training of master mariners covering different navigation syllabi.
  - i Front ended or hawse pipe entry programme covers the normal navigation syllabus meant for

- the master mariners(unlimited).
- ii Cadet entry programme covers in details and a little more navigation syllabus than is done by the front ended entry programme.
- 4 In the cadet entry programme all the countries except Argentina award a degree or a diploma in Nautical Science along with the normal certificate of competency.
  - 5 Italy and Poland spend equal time (1126 hours) on teaching navigation .
  - 6 Certificate of competency examinations.
    - 6.1 Argentina,Japan,Poland and UK are similar in requiring same percentage ( 60 %) of marks to pass in navigation in the certificate of competency written examination . Canada and Australia are also similar but they require higher percentage (70 %).
    - 6.2 In oral examinations similarity exists among Argentina,Japan and Poland who require 60 % marks and also Australia,Italy and UK who declare their candidates just pass or fail.
  - 7 Navigation syllabus consists of :
    - 7.1 All countries include "passage planning" in navigation.
    - 7.2 Australia,Japan,Poland and UK are similar in including weather routing in navigation and Canada and Italy in saying no to it.
    - 7.3 Australia,Canada,Japan and partly Argentina include "Ship Handling" in navigation.
    - 7.4 Australia ,Japan and partly Argentina include "Collision Regulations" in navigation.The others

are similar in saying no to it.

8 Upgrading courses in navigation:

- 8.1 None of the selected countries have mandatory upgrading courses in navigation.
- 8.2 All the selected countries except Italy have upgrading courses facility in navigation.
- 8.3 UK and Poland have "Manned model lake manoeuvring courses facility", meant for training master mariners or navigators who are required to serve on VLCCs. (STCW 1978 requirement)

9 Simulators:

- 9.1 All countries have Radar and ARPA simulators which is a STCW 1978 convention requirement.
- 9.2 Australia, Canada, Japan and Poland have "Navigation Equipment Simulators".
- 9.3 Australia and Japan have "Ship Simulators".
- 9.4 All countries use some kind of simulators for teaching navigation in the shore based training phase before the award of 1st certificate of competency except UK.

10 Laboratory equipment:

- 10.1 All countries have computer laboratories.
- 10.2 All countries have training vessels both sea going and small boats.

11 Student teacher ratio:

- 11.1 Argentina, Canada, Italy, UK and to some extent Poland are similar to have almost same teacher student ratio in class rooms which has been recommended in the IMO's model syllabus. On the other hand Australia and Japan are similar but different to other countries.

- 11.2 Argentina, Australia ,Canada,Italy and UK are nearly similar to each other and to IMO's recommended figures in teacher student ratio in laboratory.
- 11.3 Near similarity also exists among Canada,Poland and UK when teacher student ratio in tutorials is compared.
- 12 Effective teaching of navigation:
  - 12.1 Argentina,Australia,Canada ,Japan and UK do not consider sea orientation necessary before teaching navigation but practical exercises on board sea going ships is considered necessary for effective teaching by all the countries.
  - 12.2 Despite the availability of accurate and time saving computers and pocket calculators,teaching the use of conventional nautical tables is considered necessary to keep the students acquainted with the basic principles and a back up system in case of failure of computers etc but with reduced emphasis.
  - 12.3 All countries except UK teach the use of programmable calculators for navigational purposes.
- 13 Changes in navigation syllabus:
  - 13.1 The role of navigation syllabus with in the entire syllabus for master mariners has increased
  - 13.2 Canada, Japan , Poland and UK update their navigation syllabus every 4 to 5 years.
  - 13.3 During the last decade all countries have brought changes in their navigation syllabi to bring in line with the STCW convention.  
All countries have introduced electronic navigation and the use of computers in their

navigation syllabus.

- 13.4 All countries expect the following changes in the navigation syllabus in future.
  - i Introduction of more electronic navigation systems such as GPS (Global Positioning System), GMDSS (Global Maritime Distress and Safety System ECDIS (Electronic Chart Display) and Global communication system. Omega, Loran and R.D.F (Radio Direction Finder) etc. will disappear.
- 13.5 Emphasis on conventional navigation methods will be reduced further.
- 13.6 Greater emphasis will be placed on correct decision making based on data presentation in a one man bridge operation.
- 13.7 Computers will be used more extensively.

### Differences

- 1 Canada has not ratified Amendments 78 to SOLAS 74. In the same way MARPOL 73/78 have not been ratified by half of the selected countries.
- 2 Presentation of the navigation syllabus of all the selected countries does not tally with the presentation in the STCW 1978 Convention and with each other.
- 3 Argentina does not award a degree or a diploma to its graduates from the national maritime Academy.
- 4 Total time spent on teaching navigation:
  - 4.1 Japan spends more time than any other country on



teaching navigation , followed by Italy and Poland,Australia,Argentina and Canada.

- 4.2 Canada spends least time of all the countries on teaching navigation.
  - 4.3 Within total time spent on teaching navigation, Canada spends maximum of its time in teaching in the class rooms followed by Italy, Argentina, Poland ,Australia and Japan.
  - 4.4 Within total time spent on teaching navigation Japan spends maximum of its time on teaching navigation in the laboratories followed by Australia ,Poland ,Argentina ,Italy and Canada.
  - 4.5 The ratio of total time spent on teaching navigation to the time spent on teaching the entire nautical syllabus to the master mariners (unlimited) is the highest in Japan (54.2 %) followed by Australia ,Argentina ,Canada Poland and Italy.
  - 4.6 The time spent on teaching navigation by Canada and Argentina is even less than the IMO's recommended time for teaching navigation to the watch keepers.
- 5 Pass percentage in navigation papers:
- 5.1 Australia and Canada require their students to acquire more percentage marks(70 %) than all other countries to pass in the certificate of competency examinations.All other countries except Italy need only 60 % .
  - 5.2 Italy does not conduct written examinations at all for the award of certificate of competency to master mariners.
  - 5.3 In oral examinations Canada requires its students to acquire 90 % marks to pass.Argentina,Japan and

- Poland require only 60 %.
- 6 Position finding methods.
- 6.1 All countries spend different amount of time on teaching position finding methods. Italy spends maximum followed by Japan ,Poland , Australia Argentina and Canada.
- 6.2 All countries except Italy spend less time on teaching position finding methods than recommended by the IMO's model syllabus.
- 7 Japan has more upgrading courses facilities in navigation than any other country followed by Poland,UK,Canada,Australia and Argentina.
- 8 Simulators:
- 8.1 Japan spends more time on simulators than any other country followed by Australia,Canada,Poland UK ,Argentina and Italy.
- 8.2 Italy spends least time on simulators.
- 9 Laboratory equipment:
- 9.1 Canada and Poland have more laboratory equipment to teach navigation than any other country, followed by UK, Japan, Australia, Italy and Argentina.
- 10 Teacher student ratio:
- 10.1 Poland ,Australia and Japan have different student teacher ratio in class room which does not tally with the IMO's recommendations and other countries.
- 10.2 Japan ,Poland,Argentina and perhaps Australia differ in teacher student ratio in the laboratory as well.
- 10.3 All countries differ in teacher student ratio in tutorials as well.

- 10.4 Italy does not conduct tutorials at all.
- 11 All countries differ in providing sea orientations to the students for effective teaching of navigation.
- 12 Changes in navigation syllabus.
- 12.1 Australia and Italy update their navigation syllabus annually but Argentina every two yearly.

#### 4.3 Recommendations

- 1 The navigation syllabus of all the countries should be written and taught in English to create international understanding and co-operation.
- 2 The navigation syllabus of all the countries should be presented in a standard international format. Such a format could be agreed upon in the IMO.
- 3 The navigation syllabus should include;
  - 1 Position finding
  - 2 Collision avoidance
  - 3 Fuel economy
  - 4 Time keeping
  - 5 Pollution prevention.
- 4 All the countries should increase total time spent on teaching navigation to about 1000 hours. IMO has already suggested 845 hours which is for teaching navigation to the watch keeper level only. At least 50 % of this time should be spent on practical exercises in laboratory/

training ship etc. Practical knowledge is more important and beneficial for avoiding navigational mishaps at sea.

5 Students should be examined for the amount of navigational knowledge which was taught to them, both in written and practicals before awarding certificate of competency by all countries.

6 The attendance of upgrading courses in navigation should be made mandatory.

ANNEX

## QUESTIONNAIRE

YOU ARE KINDLY REQUESTED TO PROVIDE ME WITH INFORMATION BY ANSWERING THE FOLLOWING QUESTIONS. I NEED THIS INFORMATION FOR MY RESEARCH WORK ON "A COMPARATIVE STUDY ON NAVIGATION SYLLABI". ALL QUESTIONS RELATE TO THE EDUCATION AND TRAINING OF MASTER MARINERS (UNLIMITED/ FOREIGN GOING, CERTIFICATE OF COMPETENCY). PART ONE OF THE QUESTIONNAIRE DEALS WITH GENERAL INFORMATION ON MARITIME EDUCATION AND TRAINING SYSTEM AND PART TWO WITH NAVIGATION ONLY.

*NOTE*

*Where time units or teaching hours have been requested, they are for the entire period upto Master Mariner's certificate of competency . If you choose to give weely hours ,then please mention so and let me have total number of weeks upto master mariner's (unlimited) level.*

## (PART ONE)

1

## MARITIME EDUCATION AND TRAINING

- 1.1 Name of the country:
- 1.2 Name of the institution where Master Mariners are educated and trained.
- 1.3 Total number of such institutions including your own.

- 1.4 What are essential age and educational prerequisites for a student entering your national Maritime and Training system?

Minimum age.

Maximum age.

Number of years of general education.

Necessary subjects to be covered in general education.

e.g. Mathematics, Physics, chemistry, Geography, English etc.

- 1.5 Is some sea service necessary before entry into a training institution ? No:

Yes: How long ?

What type of ships?

- 1.6 What certificates of competency a prospective Master Mariner is required to obtain and stages or levels to pass through to become a master mariner (unlimited) ? Please tickmark as appropriate ?

3rd Mate ==> 2nd Mate ==> 1st Mate/Ch.Mate ==> Master or  
 Deck Class 1V ==> Class 111 ==> Class 11 ==> Class 1 or  
 Watch keeper 1 ==> Watch keeper 11 ==> Master or  
 Capt Class 11 ==> Capt Class 1

Please list your system if nothing above is applicable

- 1.7 Please specify minimum SEA TIME and SHORE TIME requirements from entrance into maritime academy to the award of master mariner's certificate of competency.

Certificate Level/Stage	Shore time(Months)	Sea time(Months)
i 3rd Mate or Class 1V or Watch Keeper 1		
ii Including above 2nd Mate or Class 111 or Watch. Keeper 11 or Capt. Class 11		
iii Including above- 1st Mate or Class 11 or Capt class 1		
iv Including above Master or Class 1 or Capt. Class 1		





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1.10 What is the duration of a teaching hour /time unit in minutes?

1.11 Is it necessary that the candidate should have been keeping an independent bridge watch before he may be awarded certificate of competency as master mariner ?

No,

Yes: How many months  
                    years

## (PART TWO)

2

## NAVIGATION

## 2.1 Break down of navigation syllabus.

Please indicate what subjects do you include in navigation syllabus and how many time units /teaching hours you spend on each subject ? Please also indicate pass percentage in the certificates of competency examinations.

Subject	Teaching hours		Pass
	Classroom	Lab/Practice	Percentage
	Hrs	Hrs	% Marks
Principles of Navigation	-----	-----	-----
Coastal Navigation.	-----	-----	-----
Or			
Pilotage	-----	-----	-----
Or			
Chart work	-----	-----	-----
or			
Terrestrial Navigation	-----	-----	-----
Tides and Currents	-----	-----	-----
Nautical Astronomy	-----	-----	-----
And			
Spherical Trigonometry	-----	-----	-----
Celestial Navigation	-----	-----	-----
Or			
Practical Navigation	-----	-----	-----
Or Ocean & offshore			

Navigation-----

Electronic Navigation .-----

Or Electronic Navigation-

Systems-----

Navigation Aids(Within the ship)-----

Aids to Navigation-----

(Outside of ship)

Navigational Instruments-----

or

Bridge Instruments-----

Technical Navigation-----

Or

Radio Navigation-----

Or

Satellite Navigation-----

Compasses

Magnetic-----

Gyro-----

Others

2.2 Please give time units for the followings as well .

Passage Planning-----

and

Weather routing-----

Ship handling-----

or

Ship manoeuvring-----



2.4 What simulators are used for teaching navigation ? Please indicate teaching hours/time units.

Simulators	Teaching hours.	
	Lecture	Practice
1 Radar Simulator.	-----	-----
2 ARPA "	-----	-----
3 Bridge Simulator.	-----	-----
Or Navigation Equipment Simulator.	-----	-----
Or Ship handling Simulator.	-----	-----
Or Manoeuvring simulator	-----	-----
4 Others:	-----	-----

2.5 In which semester or stage the above simulators are taught?

2.6 What laboratory equipment is used to teach navigation?

2.7 In your opinion what is the best training aid or equipment for teaching?

i Principles of navigation:

ii Celestial navigatiuon:

## iii Electronic Navigation:

2.8 How many months after the start of maritime education and training for master mariners, the teaching of navigation begins?

2.9 What subjects are taught as supporting subjects before teaching navigation?

For instance.

Mathematics. Physics,

2.10 Do you teach the use of modern pocket calculators and, personal computers etc. to work out navigational problems or exercises in the class room /laboratory etc ?

Or

You only teach the traditional Nautical and sight reduction tables ?

We teach the use of traditional navigation tables:

We teach the use of programmable navigational

(i) Pocket calculators

(ii) personal computers:

2.11 Do you think that the teaching of Nautical tables, Sight reduction tables etc. should be continued despite the availability of modern time saving and more accurate navigational calculators and personal computers now?

Yes.



No. 2.12 Do you consider sea or ship orientation necessary before teaching navigation, if so, how much such orientation you allow in your institution ?

No:

Yes:

What type of ships?

2.13 Do you take the students to ships or to sea for practical exercises in navigation during their studies at the college?

No:

Yes: How long ?

2.14 Do you update navigation syllabus from time to time ?

No.

Yes. How often ?

2.15 What is the student teacher ratio for teaching navigation in your institution ?

The student teacher ratio in class room is -----

The student teacher ratio in laboratory is-----

The student teacher ratio in tutorial/practice is-----

2.16 Has there been any change in the navigation syllabus in your institution during the last decade?

No:

Yes: What changes have you made?

2.17 What development(if any) in the role of navigation has been in the total syllabus.

There has been no change:

The importance of navigation syllabus has increased within the entire M E T syllabus as compared to a decade ago.

The importance of navigation syllabus has decreased within the entire M E T syllabus as compared to a decade ago.

2.18 With the rapid development in technology and introduction of computers, what changes do you anticipate in the navigation syllabus in future?

*REMARKS*

**APPENDIX**

NAVIGATION SYLLABUS FOR MASTER CERTIFICATE (UNLIMITED)  
AS PER  
INTERNATIONAL CONFERENCE  
ON  
TRAINING AND CERTIFICATION OF SEAFARERS, 1978

APPENDIX TO REGULATION II/2

Minimum knowledge required for certification of masters and chief mates of ships of 200 gross register tons or more

1 The syllabus given below is compiled for examination of candidates for certification as master or chief mate of ships of 200 gross register tons or more. It is intended to expand and extend in depth the subjects contained in Regulation II/4-"Mandatory Minimum Requirements for Certification of Officers in Charge of a Navigational Watch on Ships of 200 Gross Register Tons or More" Bearing in mind that a master has ultimate responsibility for the safety of the ship, its passengers, crew and cargo, and that a chief mate shall be in a position to assume that responsibility at any time, examination in these subjects shall be designed to test their ability to assimilate all available information that affects the safety of the ship. 2

2 NAVIGATION AND POSITION DETERMINATION

- (a) Voyage planning and navigation for all conditions:
- (i) By acceptable methods of plotting ocean tracks;
  - (ii) Within restricted waters;

- (iii) In ice;
  - (iv) In restricted visibility;
  - (v) In traffic separation schemes;
  - (vi) In areas of extensive tidal effects.
- (b) Position determination:
- (i) By celestial observations, including the use of sun, stars, moon and planets;
  - (ii) By celestial observations, including the ability to use bearings from landmarks and aids to navigations such as lighthouses, beacons and buoys in conjunction with appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting position fix;
  - (iii) Using all modern ship electronic navigational aids to the satisfaction of the administration, with specific knowledge of their operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing.

### 3 Watchkeeping

- (a) Demonstrate thorough knowledge of content, application and intent of the international Regulations for Preventing Collisions at Sea, including those Annexes concerned with safe navigation.
- (b) Demonstrate knowledge of Regulation II/1-"Basic Principles to be Observed in Keeping a Navigational Watch".

#### 4 Radar equipment

Demonstrate in conjunction with the use of radar simulator or, when not available, manoeuvring board, knowledge of the fundamentals of radar and ability in the operation and use of radar, and in the interpretation and analysis of information obtained from this equipment, including:

- (a) Factors affecting performance and accuracy;
- (b) Setting up and maintaining displays;
- (c) Detection of misrepresentation of information, false echoes, sea return, etc;
- (d) Range and bearing;
- (e) Identification of critical echoes;
- (f) Course and speed of other ships;
- (g) Time and distance of closest approach of crossing, meeting or overtaking ships;
- (h) Detecting course and speed changes of other ships;
- (i) Effect of changes in own ship's course or speed or both;
- (j) Application of the international Regulations for Preventing Collisions at Sea;

#### 5 Compasses - Magnetic and Gyro

Ability to determine and correct the errors of the magnetic and gyro-compasses and knowledge of the means for correcting such errors.

## 6 Meteorology and Oceanography

- (a) Demonstrate the ability to understand and interpret a synoptic chart and to forecast area weather, taking into account local weather conditions.
- (b) Knowledge of the characteristics of various weather systems, including tropical revolving storms and avoidance of storm centres and the dangerous quadrants.
- (c) Knowledge of ocean current systems.
- (d) Ability to use all appropriate navigational publications on tides and currents, including those in the English language.

## 7 Ship manoeuvring and handling

Manoeuvring and handling of a ship in all conditions, including the following:

- (a) Manoeuvres when approaching pilot vessels or stations with due regard to weather, tide, headreach and stopping distances;
- (b) Handling a ship in rivers, estuaries, etc., having regard to the effects of current, wind and restricted water on the response to the helm;
- (c) Manoeuvring in shallow water, including the reduction in keel clearance due to effect of squat, rolling and pitching;
- (d) Interaction between passing ships and between own ship and nearby banks (canal effect)
- (e) Berthing and unberthing under various conditions of wind and tide with and without



- tugs;
- (f) Choice of anchorage, anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used;
  - (g) Dragging, clearing fouled anchors;
  - (h) Dry-docking, both with and without damage;
  - (i) Management and handling of ships in heavy weather, including assisting a ship or aircraft in distress, towing operations, means of keeping an unmanageable ship out of sea trough, lessening drift and use of oil;
  - (j) Precautions in manoeuvring for launching boats or life rafts in bad weather;
  - (k) Methods of taking on board survivors from lifeboats or liferafts,
  - (l) Ability to determine the manoeuvring and engine characteristics of major types of ships with special reference to stopping distances and turning circles at various draughts and speeds;
  - (m) The importance of navigating at reduced speed to avoid damage caused by own ship's bow or stern wave;
  - (n) Practical measures to be taken when navigating in ice or conditions of ice accumulation on board;
  - (o) The use of, and manoeuvring in, traffic separation schemes.

DETAILED TEACHING SYLLABUSES, FRAMEWORKS  
OF MODEL COURSES AND SPECIMEN EXAMINATION  
PAPERS BASED ON THE 1978 STCW CONVENTION  
AND ASSOCIATED 1978 STW CONFERENCE RESOLUTIONS

Only Parties to the 1978 STCW Convention may authoritatively pronounce on the meaning and application of the Convention and the information contained in this document must be regarded as reflecting only the consensus of opinion of the contributing consultants.

5. SECTION

SUBJECTS

- 5.1 Navigation
- 5.2 Marine Operation
- 5.3 Marine Transportation
- 5.4 Meteorology
- 5.5 Nautical English
- 5.6 Medical First Aid Procedures

DETAILS

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CODE	SUBJECT	PARAGRAPH IN APPENDIX TO REGULATION II/4 S.T.C.W.	TEACHING HOURS	
			LECTURES Hours	LABORATORY Hours
5.1	<u>Navigation</u>			
5.1.1	Introduction to Navigation	1.0 and 2.0	45	45
5.1.2	Principles of Navigation	1.0	110	-
5.1.3	Coastal Navigation	2.0	-	135*
5.1.4	Ocean and Offshore Navigation	1.0 and 2.0	125	-
5.1.5	Radar Navigation	3.0	30	60*
5.1.6	Electronic Navigation Systems	5.0, 6.0, 8.0 9.0	20	70*
			<hr/>	<hr/>
			330	310
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5.2 Marine Operations

5.2.1 Proficiency in Survival Craft	12.0 +	10	30*
5.2.2 Seamanship	13.0, 14.0, 20.0 and 21.0	150	80*
5.2.3 Fire Prevention & Fire-Fighting	11.0	25	25*
5.2.4 Watchkeeping	4.0	90	-
5.2.5 Marine Communications	10.0	10	60
		<hr/> 285	195 <hr/>

5.3 Marine Transportation

5.3.1 Ship Stability	15.0	30	20
5.3.2 Ship Construction	17.0	30	10
5.3.3 Cargo Handling and Stowage	18.0	90	20
		<hr/> 150	50 <hr/>

5.4 <u>METEOROLOGY</u>	7.0	100	40
5.5 <u>NAUTICAL ENGLISH</u>	16.0	180	60
5.6 <u>MEDICAL FIRST AID PROCEDURES</u>	19.0	9	6

TOTAL	TOTAL
LECTURES = 1054	LAB = 661

+ APPENDIX  
TO REGULATION  
VI/I

TOTAL  
STUDIES = 1,715 HOURS  
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- 3 "A philosophy of navigation" Presidential Address by Wing.Comd.E.W.Anderson.The Journal of the Royal Institute of Navigation Vol.No (1961)
- 4 Proceedings of Seminar on "Seafarer's Training and Certification (3-7 October, 1983 in Kobe -Tokyo)
- 5 "The Animals as Navigators"  
by Wing.Comd.E.W.Anderson
- 6 The International Convention on Standards of Training , Certification and Watchkeeping ( STCW ) 1978.
- 7 IMO's Model Syllabus based on the STCW 1978.
- 8 Navigation Syllabus taught in the Escuela Nacional de Nautica , Argentina.

- 9 The Navigation Syllabus taught in the Australian Maritime College,Launceston -Tasmania, Australia.
- 10 The Navigation Syllabus taught in the Newfoundland and Labrador Institute of Fisheries and Marine Technology St.Jhon , Canada
- 11 The Navigation Syllabus taught in the Instituto Technico Nautico Statale Trieste , Italy
- 12 The Navigation Syllabus taught in the Higher Merchant Marine Academy in Gdynia , Poland.
- 13 The Navigation Syllabus taught in the College of Maritime studies ,Southampton ,United Kingdom.
- 14 Interviews with Capt.F.Hatzenbuhlar, Escuela Nacional de Nautica ,Argentina
- 15 Interviews with Capt.P.Muirhead ,Head School of Navigation,Australian Maritime College Launceston -Tasmania. Australia.
- 16 Interviews with Capt.D.Drown ,Head Navigation Simulators in the Newfoundland and Labrador Institute of Fisheries and Marine Technology , St.Jhon ,Canada.
- 17 Interviews with Mr.P.Stenner,Head Navigation Department ,Istituto Technico Nautico Statale, Trieste ,Italy.
- 18 Interviews with Capt.Dr.Prof.M.Jurdzinski Pro Rector.Higher Merchant Marine Academy Gdynia.Poland.