

# Comparative Study of Marine Engineering Curriculum Between MMU and PMMA

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**Abstract :** *This paper compares the marine engineering courses of two maritime institutions: Mokpo National Maritime University of Korea in the East Asia region and Philippine Merchant Marine Academy in the Southeast Asia region. It shows examines educational marine engineering programs, along with the different divisions and courses at each college. It demonstrates a divergence in methodologies and course offerings to cultivate competitive graduates. The comparative assessment completed is intended to offer broader knowledge on how each institution tackles the requirements of the STCW, and to meet the present and future demands of the maritime industry. Different course offerings are compared along with the units and hours allocated to each subject, and the differences in marine engineering academic and training requirements to graduate. Students must satisfactorily earn 150 units to complete their choice of major. Statistical procedures were used in this assessment and analysis from Excel programs.*

**Key Words :** *Marine Engineering Curriculum, Human Resources, Human Element, Maritime Education and Training, STCW 95, 2010 STCW Manila Amendments, Leadership Training*

## 1. Introduction

### 1.1 Research Background

Mokpo National Maritime University (MMU) is one of the two maritime universities in Korea and a leading institution in maritime studies and research. The Philippine Merchant Marine Academy (PMMA) is located in San Narciso, Zambales, in the Philippines. It is the only public maritime institution subsidized by the Philippine government. Both institutions offer maritime engineering courses and both countries are key players in supplying human resources for the maritime profession worldwide, both ashore and onboard ships. Both are signatories and fully compliant with the requirements of the STCW, Chapter III, Regs. 1-5, as amended (STCW, 1978).

### 1.2 Purpose and Objective

This paper introduces the curricula offered in the marine engineering divisions of two maritime institutions. A comparison is performed to demonstrate the emphasis of methodologies in their course offerings, and despite very different maritime environments and economic standings, the two countries' maritime pedagogy

(Dimailig, et al., 2010) never differs in pursuit of excellence for graduates who will serve each country's maritime needs, in full accord with the STCW and its latest amendments.

## 2. Maritime Education and Training

### 2.1 The Amended STCW Requirements

The STCW Convention contains regulations supported by sections of the STCW Code. Generally speaking, the convention contains basic requirements which are elaborated in the code. Part A of the code is mandatory. Part B contains recommendations intended to help implement the convention. The measures suggested are not mandatory and the examples given are only intended to illustrate how certain convention requirements may be complied with. The Manila amendments represent the latest major revision of the STCW convention and code taken by the IMO and adopted on 25 June 2010, entering into force on 1 January 2012.

The STCW has 8 chapters, wherein Chapter III, deals exclusively with the engine department, describing basic principles to be observed by personnel for safety. This chapter contains regulations 1-5 for engineer officers and regulation 6 for ratings forming part of an engine room watch (STCW, 1978).

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2.2 The MMU Marine Engineering MET (MMU, 2015a)

The MMU Marine Engineering MET is composed of three divisions: the Marine Engineering System; Ocean Power System and Marine Safety; and Marine Mechatronics.

All three of these divisions have common liberal arts and Department of Marine Engineering courses, and each has its own compulsory subjects and electives a student can choose from to satisfy the academic requirements of the university.

Liberal arts courses require a minimum of 30 units, and the Department of Marine Engineering requires 75 mandated units. To graduate, a student must complete 150 units from his/her choice of major.

2.2.1 Division of Marine Engineering [A] (MMU, 2015b)

The Marine Engineering System Division has four departments: Marine Engineering; Mechanical Application; Electrical and Control Engineering; and Ocean Energy and Offshore Plants.

Table 1. First year (Freshman) curriculum [A]

Course		First Year - Marine Engineering System					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	Hrs
Liberal Arts	Compulsory	Differential & Integral Calculus 1	2	2	Swimming	1	2
		Physics 1	2	2	English 2	1	1
		English 1	1	2	English Conversation 2	1	2
		English Conversation 1	1	2	Writing & Announcement	1	2
		Computer Programming	2	3	Engineering Mathematics	2	2
					(Shipboard Life Training) (Dormitory Leadership 1)	1	
		8	11	Subtotal	7	9	
	Elective	Elec	Mathematics (Subject 5)				0
			Science (Subject 4)				0
			Computer Statistics (Subject 4)				0
		Main	Literature & Culture (Subject 4)				1
			History & Philosophy (Subject 5)				2
Humans & Society (Subject 5)						2	
			Science & Technology (Subject 4)	2			
			Art (Subject 4)	1			
			Subtotal	8			
Major	Compulsory	Mathematics (Subject 5)				0	
		English & Second Foreign Language (Subject 17)				0	
		Leadership & Life (Subject 10)				0	
		Sports (Subject 6)					
		Electrical Engineering	3	3	Thermodynamics	3	3
		Ship Construction Stability	2	2	Fluid Mechanics	3	3
			General Service & Int'l Maritime Regulations	3	3		
			Metal Material	3	3		
	8	8	Subtotal	12	12		

Table 2. Second year (Sophomore) curriculum [A]

Course		Second Year - Marine Engineering System					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	Hrs
Liberal Arts	Compulsory	English Conversation 3	3	2	(Shipboard Life-Training) (Dormitory Leadership II)	1	
		General Chemistry	2	2			
		Subtotal	3	4	Subtotal	1	
Major	Compulsory	Int'l Combustion Engine	3	3	Maritime Law	2	2
		Sequential Control	3	3	Ref & Air-con System	3	3
		Marine Aux Machinery	3	3			
		9	9	Subtotal	5	5	
Major	Compulsory	Strength of Materials	3	3	Automatic Control	2	2
					Ext Combustion Engine	2	2
					Mechanical Dynamics	3	3
		3	3	Subtotal	7	7	
Major	Elective	Oil Hydraulic Engineering	3	3	Machine Fluid Mechanics	3	3
		Welding	3	3	Air Conditioning	3	3
					Numerical Analysis	3	3
		6	6	Subtotal	9	9	
Major	Compulsory	Strength of Materials	3	3	Automatic Control	2	2
					Ext Combustion Engine	2	2
					Mechanical Dynamics	3	3
		3	3	Subtotal	7	7	
Major	Elective	Electro-magnetics	3	3	Digital Engineering	3	3
		Electric Circuit Theory	3	3	Instrumentation Engineering	3	3
					Electric Design	3	3
		6	6	Subtotal	12	12	
Major	Compulsory	Strength of Materials	3	3	Automatic Control	2	2
					Ext Combustion Engine	2	2
					Mechanical Dynamics	3	3
		3	3	Subtotal	7	7	
Major	Elective	Instruction to Ocean Energy	3	3	Instruction to Offshore Plant	3	3
		Oil Energy	3	3	Electric Propulsion & Power Transfer	3	3
		(Offshore Plant Method Engineering)	3	3	Hydropneumatic Engineering	3	3
		9	9	Subtotal	9	9	

Table 3. Third year (Junior) curriculum [A]

Course		Third Year - Marine Engineering System					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	Hrs
Major	Compulsory	Maritime English	3	3	Eng Synthesis Training 1	1	15
		Machine Shop Welding Lab	2	3			
		Mechanical & CAD	2	3			
		7	9	Subtotal	15		
Major	Elective	Instrumentation Engineering	2	2			
		Machine Design	3	3			
		Liquid Cargo-handling Machine	3	3			
		3	3	Theory of Material Test	3	3	
		3	3	Vibration Engineering	3	3	
		3	3	Capstan Design 1	3	3	
		17	17	Subtotal	17		
Major	Elective	Power Conversion System	3	3			
		Electronic Engine Control	3	3			
		Modern Control	3	3			
		3	3	Sensor & Signal Processing	3	3	
		3	3	Microprocessor	3	3	
		3	3	Capstan Design 1	3	3	
		18	18	Subtotal	18		
Major	Elective	Ocean Energy Plant Design	3	3			
		Electronic Engine Control	3	3			
		Steam Power Engineering	3	3			
		3	3	Offshore Construction Building & Design	3	3	
		3	3	Capstan Design 1	3	3	
		15	15	Subtotal	15		

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Table 4. Fourth year (Senior) curriculum [A]

Course		Fourth Year - Marine Engineering System					
		First Semester			Second Semester		
		Subject	Units	Subject	Units	Hrs	
Liberal Arts	Comp			Shipboard Life Training Leadership III	1		
				Subtotal	1		
Major	Comp	Engine Training 2	15	Oil & Marine Pollution	3	3	
				Subtotal	3	3	
Major	Elective			Youth Employment School	1	2	
				Subtotal	1	2	
Major	Comp			Elect. Electric Measurement Practice	2	3	
				Subtotal	2	3	
Major	Elective			Heat Transfer	3	3	
				Engine Simulation	1	2	
Major	Elective			Corrosion	3	3	
				Power Transfer Engineering	2	2	
Major	Elective			Internal Combustion Engine II	2	2	
				Engine Design	3	3	
Major	Elective			Capstan Design II	3	3	
				Subtotal	17	18	
Major	Comp			Electricity. Elect Measurement Practice	2	3	
				Subtotal	2	3	
Major	Elective			Engine Simulation	1	2	
				Deck Machinery & Unloader Control	3	3	
Major	Elective			Ship Automation & Network	2	2	
				Nav & Radio Comm Equipment	3	3	
Major	Elective			Capstan Design II	3	3	
				Subtotal	12	13	
Major	Comp			Electricity · Elect Measurement Practice	2	3	
				Subtotal	2	3	
Major	Elective			Ocean Drilling & DPS	3	3	
				Offshore Plant Welding	3	3	
Major	Elective			Special Lecture on Ocean Energy Plants	3	3	
				Engine Simulation	1	2	
Major	Elective			Capstan Design II	3	3	
				Placement - OJT / Practicum	3	3	
				Subtotal	16	17	

Table 5. Summary of major subjects [A]

Division of Marine Engineering System		
Departments	Total Subjects	
	Compulsory	Electives
1st Major - Marine Engineering	18	1
2nd Major - Mechanical Application	5	12
2nd Major - Electrical & Control Engineering	5	17
2nd Major - Ocean Energy & Offshore Plants	5	18

### 2.2.2 Division of Ocean Power System and Marine Safety [B] (MMU, 2015b)

The Ocean Power System and Marine Safety Division has three departments: Marine Engineering, Ocean Power System and Maritime Safety Administration.

Table 6. First year(Freshman) curriculum [B]

Course		First Year - Ocean Power System & Marine Safety					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	Hrs
Liberal Arts	Compulsory	Engineering Mathematics	2	2	Physics	2	2
		Diff & Integral Calculus 1	2	2	Swimming	1	2
		English 1	1	1	Shipboard Life Training Dormitory Leadership I	1	2
		General Chemistry	2	2			
		Subtotal	7	7	Subtotal	4	6
Liberal Arts	Basic	Mathematics (Subject 5)					0
		Science (Subject 4)					0
		Computer. Statistics (Subject 4)					0
		Subtotal					0
Liberal Arts	Main Elective	Literature & Culture (Subject 4)					1
		History & Philosophy (Subject 5)					2
		Human & Society (Subject 5)					2
		Science & Tech (Subject 4)					2
		Subtotal				8	
Major	Main Leadership	Marine Exploration (Subject 7)					2
		English & Second Foreign Language (Subject 17)					0
		Leadership & Life (Subject 10)					0
		Sports (Subject 6)					0
		Subtotal				2	
Major	Compulsory	Gen Serv & Int'l Mar Regs	3	3	Thermodynamics	3	3
		Fluid Mechanics	3	3	Electrical Engineering	3	3
		Machine Shop-Welding Lab	2	3	Refrigeration & Air-con	3	3
					Mechanical & CAD	2	3
		Subtotal	8	9	Subtotal	13	14

Table 7. Second year(Sophomore) curriculum [B]

Course		Second Year - Ocean Power System & Marine Safety					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	Hrs
Liberal Arts	Compulsory	Computer Language	2	3	Shipboard Life Training Dormitory Leadership II	1	2
		English Conversation 1	1	2	English Conversation 2	1	2
					English 2	1	1
		Subtotal	3	5	Subtotal	3	5
Major	Compulsory	Int Combustion Engine	3	3	Maritime English	3	3
		Electronics	3	3	Oil & Marine Pollution	3	3
					Sequential Control	3	3
		Subtotal	6	6	Subtotal	9	9
Major	Comp	Measurement & Control	3	3	Ext Combustion Engine	2	2
		Subtotal	3		Subtotal	2	
		Instrumentation to Engine System	3	3	Digital Engineering	3	3
		Combustion Engineering	3	3	Steam & Gas Turbine	3	3
Major	Elective	Heat Transfer	3	3	Electronics Circuits	3	3
		(Propulsion & Power Transfer Equipment)	3	3	Material Dynamics	3	3
		Subtotal	12	12	Subtotal	12	12
		Measurement & Control	3	3	Ext Combustion Engine	2	2
Major	Comp	Maritime Police Theory	3	3	Subtotal	2	2
		Subtotal	6	6	Subtotal	2	2
		Constitution	3	3	Law of the Sea	3	3
		Criminal Law	3	3	Code of Criminal Procedure	3	3
Major	Elective	Chivalry 1	1	2	Maritime Police Affairs Theory	3	3
					Chivalry 2	1	2
		Subtotal	7	8	Subtotal	10	11

Table 8. Third year(Junior) curriculum [B]

Course		Third Year - Ocean Power System & Marine Safety					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	
Major	Liberal Arts	Comp	English Conversation 3	1	2		
			Subtotal	1	2		
	Dept of Marine Engineering	Comp	Marine Aux Machinery	3	3	Engine Synthesis Training 1	15
			Subtotal	3	3	Subtotal	15
	Dept of Ocean Power System	Comp	Mechanical Dynamics	3	3		
			Electrical Machinery	2	2		
			Subtotal	5			
		Elective	Sequence Practice	3	3		
			Welding	3	3		
			Power Conversion Engineering	3	3		
			Offshore Plant System	2	2		
	Electricity · Electric Measurement Practice	2	3				
	Subtotal	13	14				
	Dept of Maritime Safety Administrations	Comp	Law of the Sea	2	3		
			Subtotal	2	3		
		Elective	Maritime Police Theory	3	3		
			Administrative Law	3	3		
			The Science of Govt.	3	3		
			Search & Rescue Theory	3	3		
			Mechanical Dynamics	3	3		
Electrical Machinery	2	2					
Subtotal	17	17					

Table 9. Fourth year(Senior) curriculum [B]

Course		Fourth Year - Ocean Power System & Marine Safety						
		First Semester		Second Semester				
		Subject	Units	Subject	Units	Hrs		
Major	Liberal Arts	Compulsory		Writing & Announcement	1	2		
				(Shipboard Life Training Dormitory Leadership III)	1	2		
			Subtotal	2	4			
	Marine Engineering	Comp	Engine Synthesis Training 2	15	Metal Material	3	3	
			Subtotal	15	Ship Construction & Stability	2	2	
	Dept of Ocean Power System	Comp			Engine Simulation	2	3	
					Subtotal	2	3	
					Leadership & Teamwork	2	2	
		Elective				Extremely Low Temp & LNG Engineering	3	3
						Sensor and Signal Processing	3	3
						Electric Propulsion System	2	2
						Engine Failure & Trouble shooting	3	3
	Subtotal			13	13			
	Dept of Maritime Safety Adminn	Comp			Engine Simulation	2	3	
					Subtotal	2	3	
		Elective				Marine Investigation Theory	3	3
						Prevention of Marine Pollution Theory	3	3
					Leadership & Teamwork	2	2	
	Subtotal			8	8			

Table 10. Summary of major subjects [B]

Division of Ocean Power System & Maritime Safety		
Departments	Total Subjects	
	Compulsory	Electives
1st Major - Marine Engineering	18	0
2nd Major - Ocean Power System	5	18
2nd Major - Maritime Safety Administration	5	16

2.2.3 Division of Marine Mechatronics [C] (MMU, 2015b)

The Division of Marine Mechatronics consists of two departments, Marine Engineering and Electro-Technical System Engineering.

Table 11. First year(Freshman) curriculum [C]

Course		First Year - Marine Mechatronics						
		First Semester			Second Semester			
		Subject	Units	Hrs	Subject	Units	Hrs	
Compulsory	Liberal Arts	Calculus 1	2	2	Engineering Mathematics	2	2	
		Physics	2	2	Chemistry	2	2	
		Computer Programming	2	3	English 2	1	1	
		English 1	1	1	English Conversation	1	2	
		English Conversation	1	2	Shipboard Life Training Dormitory Leadership I	1		
		Subtotal	8	10	Subtotal	7	7	
		Basic	Mathematics (5)				0	
			Science (4)				0	
			Computer. Statistics (4)				0	
		Subtotal				0		
Main	Literature & Culture (4)				1			
	History & Philosophy (5)				2			
	Humans & Society (5)				2			
	Art (4)				1			
Subtotal				8				
Marine Leadership	Marine Exploration (7)				2			
	English & Second Foreign Language (17)				0			
	Leadership & Life (10)				0			
	Sports (6)				0			
Subtotal				2	30			
Compulsory	Marine Engineering	Electrical Engineering	3	3	Thermodynamics	3	3	
		Machine Shop Weld Lab	2	3	Fluid Mechanics	3	3	
					Electronic Engineering	3	3	
					Metal Material	3	3	
		Subtotal	5	6	Subtotal	12	12	
Comp	Strength of Materials Basic	2	3					
	Subtotal	2	3					
Elective	Ship Officer's Career & Consultation	2	2	MOS	2	2		
				Microsoft Office Specialist				
	Subtotal	2	2	Subtotal	2	2		

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Table 12. Second year(Sophomore) curriculum [C]

Course		Second Year - Marine Mechatronics						
		First Semester			Second Semester			
		Subject	Units	Hrs	Subject	Units	Hrs	
Liberal Arts	Compulsory				Swimming	1	2	
					Shipboard Life Training Dormitory Leadership II	1		
					English Conversation 3	1	2	
					<b>Subtotal</b>	<b>3</b>	<b>4</b>	
Marine Leadership	Marine Engineering	Compulsory	Int. Combustion Engine	3	3	Maritime English	3	3
			Marine Aux Machinery	3	3	Maritime Law	2	2
			Refrigeration & Air-Cond.	3	3	Machine Drawing & CAD	2	3
			<b>Subtotal</b>	<b>9</b>	<b>9</b>	<b>Subtotal</b>	<b>7</b>	<b>8</b>
	Dept of Electro-Technical System Engineering	Comp	Circuits Experiment	2	3	Automatic Control	3	3
			Electro-magnetics	3	3			
			<b>Subtotal</b>	<b>5</b>	<b>6</b>	<b>Subtotal</b>	<b>3</b>	<b>3</b>
			Theory of Material Test	2	3	Int. Combustion Engine II	2	2
		Elective	Hydraulic Machinery	2	2	Distribution of High Voltage Electric Power	3	3
					Electro-magnetics App	2	2	
					Circuits Application	2	2	
			<b>Subtotal</b>	<b>4</b>	<b>5</b>	<b>Subtotal</b>	<b>9</b>	<b>9</b>

Table 13. Third year(Junior) curriculum [C]

Course		Third Year - Marine Mechatronics					
		First Semester			Second Semester		
		Subject	Units	Hrs	Subject	Units	
Marine Leadership	Dept of Marine Engineering	Compulsory	Gen Services & Maritime Law	3	3	Engine Synthesis Training 1	15
			Sequential Control	3	3		
			Ship Construction & Stability	2	2		
			<b>Subtotal</b>	<b>8</b>	<b>8</b>		
	Dept of Electro-Technical System Engineering	Comp	External Combustion Engine	2	2		
			<b>Subtotal</b>	<b>2</b>	<b>2</b>		
		Elective	Special Cargo Machinery	2	2		
			Instrumentation Engineering	3	3		
			Electrical Machinery	3	3		
			Digital Engineering	2	2		
			<b>Subtotal</b>	<b>10</b>	<b>10</b>		

Table 14. Fourth year(Senior) curriculum [C]

Course		Fourth Year - Marine Mechatronics					
		First Semester			Second Semester		
		Subject	Units		Subject	Units	Hrs
Liberal Arts	Compulsory				Writing & Announcement	1	2
					Shipboard Life Training Dormitory Leadership III	1	
					<b>Subtotal</b>	<b>2</b>	<b>2</b>

Table 14. (continued)

Engineering	Marine	Comp	Engine Synthesis Training II	15	Oil & Marine Pollution	3	3
			<b>Subtotal</b>	<b>15</b>	<b>Subtotal</b>	<b>3</b>	<b>3</b>
Marine Leadership	Elective				Heat Transfer	2	2
					Leadership & Teamwork	2	2
					Corrosion	2	2
					Engine Simulation	2	2
					Youth Employment Academy	1	2
					Electronic Navigation	2	2
					Power Engineering	2	2
					Electro-Propulsion System	2	2
					Wireless Communication	2	2
					<b>Subtotal</b>	<b>17</b>	<b>18</b>

Table 15. Summary of major subjects [C]

Division of Marine Mechatronics		
Departments	Total Subjects	
	Compulsory	Electives
1st Major - Marine Engineering	18	0
2nd Major - Electro-Technical System Engineering	5	21

2.3 The PMMA Marine Engineering MET (PMMA, 2017)

The College of Marine Engineering is one of two colleges at PMMA. It offers only one major as a baccalaureate degree, a Bachelors of Science in Marine Engineering. Its curriculum strictly follows the Commission on Higher Education (CHED) Memorandum Order (CMO) No. 20 Series of 2014, which sets guidelines for seagoing service requirements for BSMarE programs to ensure compliance with the provisions of the 1978 STCW Convention and Code, as amended (CMO, 2014). Students must earn 219 units to graduate. The program follows a block academic system, where subjects are pre-arranged and all students must adhere to the requirements. Needless to say, there are no elective subjects.

The academy life is strictly regimented and its regimental rules and regulations are firmly observed. Education takes place in classroom setting. All students are categorized as cadets, but they are mostly addressed as “midshipman/woman.” Freshmen are called “Fourth Class Midshipmen” sophomores are called “Third Class Midshipmen” Juniors are addressed as “Second Class” and seniors are “First Class Midshipmen.”

Table 16. Fourth class, 1st semester curriculum

Fourth Class (Freshmen) - First Semester					
Code	Title	Course Description	Lec	Lab	Units
GenEd 1	English 1	Study and Thinking Skills in English	3		3
GenEd 7	Info Tech	Computer Application and Networking	2	3	3
GenEd 8	Math 1	College Algebra	3		3
GenEd 11	Nat. Science 1	General Physics	2	3	3
GenEd 15	Soc Sci 1	Gen Psychology with Alcohol/Drug Prev.	3		3
SPC 11	Mar-E Drawing	Marine Engineering Drawing	2	3	3
SPC 16	Ma Shop 1	Shop Safety, Hand & Power Tools	2	3	3
SPC 23	Naval Archi. 1	Ship Routine and Seamanship	3		3
Phy Ed 1	PE 1	Basic Swimming		2	2
Total per week - Hours and Units			20	14	26
NSTP 1	NS 11	Basic Course - ROTC	4		1.5
NSTP 2	NS 12	Basic Course - ROTC	4		1.5
RRR 1	Aptitude	Leadership Training - 24H Operation			1
RRR 2	Aptitude	Discipline Training - 24H Operation			1

Table 17. Fourth class, 2nd semester curriculum

Fourth Class (Freshmen) - Second Semester					
Code	Title	Course Description	Lec	Lab	Units
GenEd 2	English 2	Writing in the Discipline	3		3
GenEd 9	Math 2	Plane Trigonometry and Solid Mensuration	3		3
GenEd 12	Nat. Science 2	Applied Physics	2	3	3
GenEd 13	Nat. Science 3	General Chemistry	2	3	3
GenEd 16	Soc Sci 2	Society & Culture with FP, STD, HIV, AIDS	3		3
SPC 3	Electro Tech. 1	Electro Technology (Basic Electricity)	2	3	3
SPC 17	Ma Shop 2	Machine Tool	1	6	3
SPC 27	Protect Mar Env	Marine Pollution & Prevention (Annex 1-6)	3		3
SPC 28	Safety 1	Basic Training***	2	3	3
Phys Ed 2	PE 2	Advanced Swimming		2	2
Total per week - Hours and Units			21	20	29
NSTP 3	NS 21	Basic Course - ROTC	4		1.5
NSTP 4	NS 22	Basic Course - ROTC	4		1.5
RRR 3	Aptitude	Leadership Training - 24H Operation			1
RRR 4	Aptitude	Discipline Training - 24H Operation			1

Safety 1 - To be offered at the training center during semester break

Table 18. Third class, 1st semester curriculum

Third Class (Sophomore) - First Semester					
Code	Title	Course Description	Lec	Lab	Units
GenEd 3	English 3	Speech Communication with IMO SMCP	3		3
GenEd 5	Humanities 1	World Culture and Geography	3		3
GenEd 10	Math 3	Calculus and Analytic Geometry	3		3
GenEd 17	Soc Sci 3	Politics and Governance with Phil. Consti.	3		3
SPC 1	Aux Mach 1	Aux. Mach. Basic Const & Operating Principles	2	3	3
SPC 4	Elec-Tech. 2	Electro-Technology (Marine motor/Generator)	3	3	4
SPC 18	Ma Shop 3	Fabrication, Welding, Joining & Cutting	1	6	3
SPC 24	Naval Archi. 2	Ships Construction and Stability	3		3
SPC 31	Thermodynamics	Thermodynamics for Marine Engineers	3		3
Phys Ed 3	PE 3	Team Sports	0	2	2
Misc 1	CES 4.3**	CES Training Module 4.3		(2)	
Total per week - Hours and Units			24	14	30
NSTP 5	NS 31	Advance Course - ROTC	4		2
RRR 5	Aptitude	Leadership Training - 24H Operation			1
RRR 6	Aptitude	Discipline Training - 24H Operation			1

Note: \*\* To be reflected in the students' class schedules.

Table 19. Third class, 2nd semester curriculum

Third Class (Sophomore) - Second Semester					
Code	Title	Course Description	Lec	Lab	Units
GenEd 4	English 4	Research and Thesis Writing	3		3
GenEd 6	Humanities 2	Ethics	3		3
GenEd 14	Rizal course	The Life, Works and Writings of Jose Rizal	3		3
SPC 5	Elec-Tech. 3	Application of Marine Electronic System	2	3	3
SPC 8	E watch*	Watch-keeping with ERS (Operational Level)	3	2	3
SPC 14	Mar Re & AC	Marine Refrigeration, Air-Con & Ventilation Sys	1	3	2
SPC 20	MPS 1	Marine Steam Propulsion System	2	3	3
SPC 25	Navigation	Navigation for Engineers	1	3	2
SPC 32	Tribology	Industrial Chem (Fuel Oil & Lubricants)	3	2	3
PhyEd 4	PE 4	Dual Sports		2	2
Total per week - Hours and Units			21	18	27
NSTP 6	NS 32	Advance Course - ROTC	4		2
RRR 7	Aptitude	Leadership Training - 24H Operation			1
RRR 8	Aptitude	Discipline Training - 24H Operation			1

\* EWatch - To be offered at the training center during semester break

## Comparative Study of Marine Engineering Curriculum Between MMU and PMMA

During their second year of academy life, selected cadets are sent every week in groups of 16 or more to the Subic Bay Metropolitan Authority (SBMA), where the academy has an MOA to man, maintain and operate six SBMA sea-crafts. There, the cadets are taught the practical side of seamanship and engine works.

They learn line-handling, personnel transferring, patrolling for specific areas of the bay, and more. During weekends, each boat is inspected for damage, and repairs or improvements are carried out. Actual maintenance of engines, machinery and bunkering are also performed.

These practical tasks prepare the cadets for their eventual shipboard training in their third year of education.

During their third year, midshipmen are required to serve a minimum of 12 months as Engine Cadets or Apprentice Engineers as mandated by CHED CMO 20, series of 2014 (CMO, 2014), on board mostly foreign ocean-going vessels. They carry with them sea-projects, which they have to complete and submit upon disembarkation. They are also required to accomplish and submit additional assignments by correspondence in every quarter.

Table 20. Second class, phase I sea project

Second Class (Junior) Sea Project - Phase I			
Code	Title (Function)	Course Description	Units
ST 1	MES 1	Marine Engineering System (Operational Level)	5
ST 2	EECE 1	Electrical Electronic & Control Engineering (OIC)	5
ST 3	MAR 1	Maintenance & Repair (Operational Level)	5
ST 4	COSCP 1	Control the Opn of the Ship & Care for Persons on-board (OIC)	5
Total Units			20

Table 21. Second class, phase II sea project

Second Class (Junior) Sea Project - Phase II			
Code	Title (Function)	Course Description	Units
ST 5	MES 2	Marine Engineering System (Operational Level)	5
ST 6	EECE 2	Electrical, Electronic & Control Engineering (OIC)	5
ST 7	MAR 2	Maintenance & Repair (Operational Level)	5
ST 8	COSCP2	Control the Opn of the Ship & Care for Persons on-board (OIC)	5
Total Units			20

After satisfying all requirements during 12 months of supervised shipboard training, Mar-E midshipmen return to the academy for their final academic year.

Table 22. First class, 1st semester curriculum

First Class (Senior) - First Semester					
Code	Title	Course Description	Lec	Lab	Units
SPC 2	Aux Mach 2	Preparation, operation and fault detection	2	3	3
SPC 9	Fluid Power	Pneumatics / Hydraulics System	3	2	3
SPC 12	Marine Auto 1	Instrumentation and Controlling Elements	2	3	3
SPC 15	Mar-Law	Maritime Law	3	0	3
SPC 19	Mechanics	Mechanics and Hydromechanics	4	0	4
SPC 21	MPS 2	Marine Diesel and Electric Propulsion System	2	3	3
SPC 29	Safety 2	Advance Training***	2	3	3
SPC 30	Sec Awareness	Security Awareness (ISPS)	2		2
Total per week - Hours and Units			20	14	24
NSTP 7	NS 41	Advance Course - ROTC	4		2
RRR 9	Aptitude	Leadership Training - 24H Operation			1
RRR 10	Aptitude	Discipline Training - 24H Operation			1
Safety 2 - To be offered at the training center during semester break					

Table 23. First class, 2nd semester curriculum

First Class (Senior) - Second Semester					
Code	Title	Course Description	Lec	Lab	Units
SPC 6	EMAT	Engineering Material	3	0	3
SPC 7	ERM	Engine Resource Management	1	3	2
SPC 10	Maint & Repair	Shipboard Maintenance and Repair	2	3	3
SPC 13	Marine Auto 2	Automation Control and Application with PLC	2	3	3
SPC 22	MPS 3	Tri-fuel Diesel and Gas Turbine Propulsion	2	3	3
SPC 26	Pers Man & Training	Shipboard Personnel Management	3		3
Misc 2	ERS	Engine Room Simulator (Management Level)		(2)	
Total per week - Hours and Units			13	12	17
NSTP 8	NS 42	Advance Course - ROTC	4		2
RRR 11	Aptitude	Leadership Training - 24H Operation			1
RRR 12	Aptitude	Discipline Training - 24H Operation			1

### 3. Discussions

#### 3.1. Mar-E Curricula Comparative Assessment

The engineering education curriculum MMU and PMMA have been compared, following the breakdown of the curricular and training programs of both institutions as described in the previous chapter. The differences in curriculum design and delivery methodology as contained in the requirements of STCW 1978, as amended in 1995 (STCW 95), have also been addressed.

The social climate in the two countries and the attitudes of the maritime communities in relation to the maritime programs offered has also been illustrated, with regard to the quality of competent maritime graduates.

#### 3.2. PMMA Mar-E curriculum

The graphs in Fig. 1. Summarize the courses and required units for a student to complete his/her Mar-E education at PMMA. A cadet must complete 219 units to graduate. Overall, 134 units (61 %) are required for major subjects, including shipboard training, while 85 units (39 %) are required for general education and non-general education subjects (PMMA, 2017).

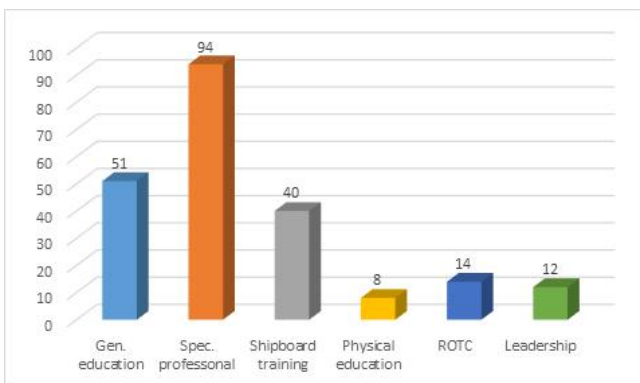


Fig. 1. PMMA Mar-E summary of units per courses.

General education subjects are those mandated by CHED CMO No. 32 series of 2013 (CMO, 2013) and the PMMA Regimental Rules and Regulations to qualify for a baccalaureate degree. These subjects are not offered during cadets' shipboard training, and only a minimal 8 units are covered during senior year, where the maximum concentration of major subjects (30 %) are taught.

#### 3.3. MMU Mar-E curriculum

The MMU Mar-E curriculum has been revised for SY 2015. Under the new curriculum, new freshmen of SY 2015 have to

acquire a minimum of 150 units to graduate (MMU, 2015a).

A minimum of 30 units are required for liberal arts subjects, with 20 mandatory units. The remaining units are elective subjects, with 102 subject offerings to choose from.

Fig. 2. demonstrates the required units for the offered courses. The graph shows only the required 138 units, and students can select the remaining 12 units to complete the 150 units required for graduation from an array of electives courses for each department major or non-major course.

The tables in sub-sections 2.2.1-2.2.3 show the curricula of the three divisions of the university's marine engineering offerings.

Each division must comply with the compulsory subjects/units of the Liberal Arts Department with a minimum of 20 units and the major courses of the Department of Marine Engineering with 18 units each. These two departments are common to all marine engineering divisions.

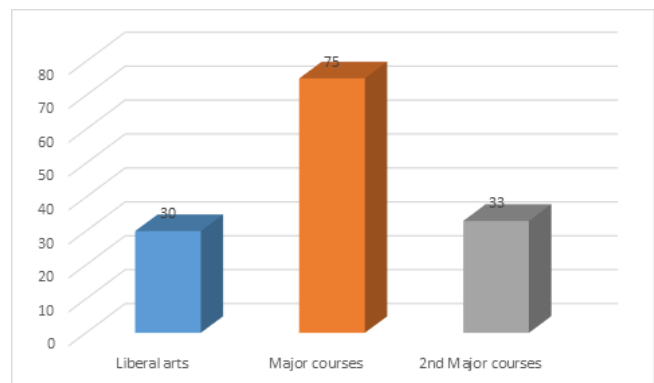


Fig. 2. MMU Mar-E summary of minimum units per courses.

All divisions have their own second major departments, each with 5 mandatory courses and various selective courses for students to choose from see Tables 5, 10 and 15.

A student must earn a total of 150 units to be eligible for graduation (MMU, 2015a).

The two universities have different curricula, with slightly different trends. As a result, this paper is important for providing more specific details for planning engineering education curriculum.

### 4. Conclusions

Although both comply with the guidelines of the STCW 95, as amended, it has been observed that the two maritime institutions have different approaches to meeting the code's Chapter III requirements.



They also differ extensively in terms of course offerings, where MMU has more technical subjects of both mandatory and elective types. This reflects the maritime environment of the country in which it is based, with numerous leading technical manufacturing plants and, shipyards where maritime technology is researched and eventually applied to manufacturing.

A student has to earn 150 units to complete his/her choice of major. Of this, a minimum of 75 units (50 %) are required for a 1st major, a minimum of 30 units (20 %) for liberal arts subjects and 33 units (22 %) for 2nd major. The remaining 12 units can be fulfilled from an array of elective courses.

On the available number of subjects, the 1st major department, Marine Engineering, which is required for all divisions, has 18 compulsory subjects and 1 elective on offer. Similarly, the 2nd major departments have plenty of subjects to choose from: the Division of Marine Engineering System has 15-compulsory subjects and 47 elective; the Division of Ocean Power System and Maritime Safety has 10-compulsory subjects and 34 electives; the Division of Marine Mechatronics has 5 compulsory subjects and 21 electives (MMU, 2015a, MMU, 2015b).

The Philippines has had a reputation as a major supplier of human resources onboard foreign principals for quite a while, and the PMMA Mar-E program caters best to this environment. Its course offerings, while in a block system where students have no choice of subjects, serves well in the present maritime education context.

To be conferred a Bachelor of Science in Marine Engineering, a cadet has to complete 41 major subjects with no electives. This includes 7 major subjects (17 %) in the first year, 11 (27 %) in the second year, and 8 (20 %) in the third year. These courses entail the submission of required sea projects, assignments and training record books (TRB) as per Section A III/I of the STCW 78, as amended. The bulk of the remaining subjects are taken during the fourth year of education, when 15 (37 %) units are earned.

General education subjects are mostly mandated by CHED. Non-major subjects, include discipline, physical education and ROTC (a requirement for all cadets as they are automatically conferred reserve officer ranks in the Philippine Navy, with a direct commissionship for Philippine Navy and Coast Guard scholars upon graduation).

These subjects are covered entirely in the 1st year 20 units and 2nd year 16 units with none in the 3rd or 4th years of education and training.

## Abbreviations

CHED	- Commission on Higher Education
CMO	- CHED Memorandum Orders
Mar-E	- Marine Engineering
MET	- Maritime Education and Training
MMU	- Mokpo National Maritime University
PMMA	- Philippine Merchant Marine Academy
STCW	- Standards of Training, Certification and Watchkeeping

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- [3] Dimailig, O. S., J. Y. Jeong and C. S. Kim(2010), Comparative Review of Marine Transportation Education between Korea and the Philippines. pp. 73-76, pp. 77-78.
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