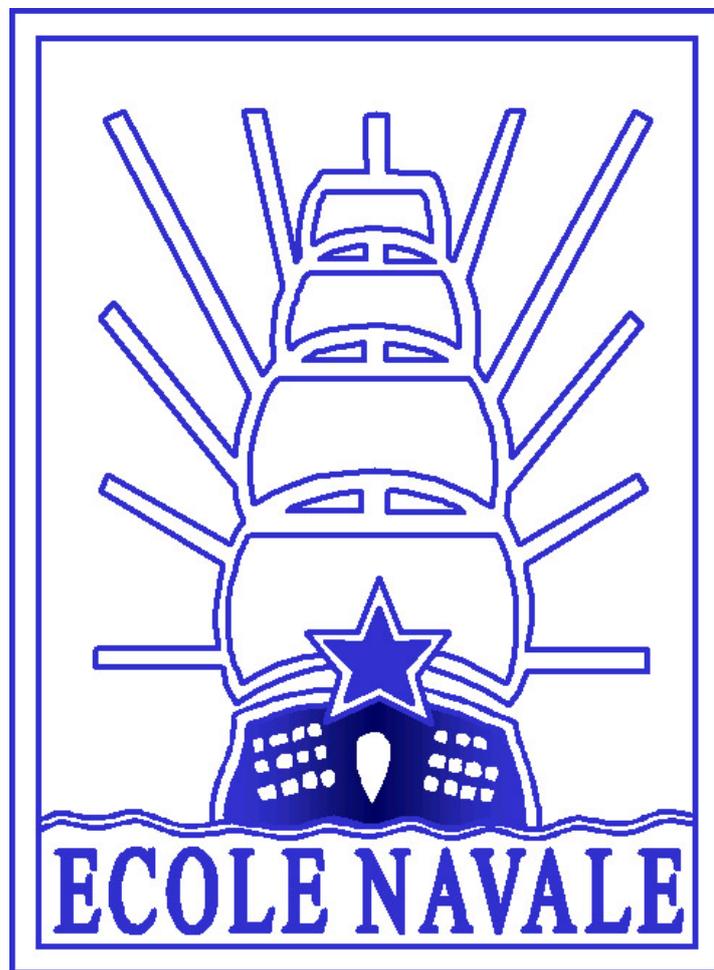


**ECOLE NAVALE**

**EDUCATION DEPARTMENT**

**THIRD SEMESTER**

**TRAINING OF THE EXECUTIVE OF THE NATION  
SCIENTIFIC TRAINING BY OPTION**



**HISTORICAL REVIEW OF THE DOCUMENT**

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# INTRODUCTION

## 1. GENERAL MATTERS

At the end of the second semester, cadets are shared out into two different syllabuses, according to their results and wishes:

- Engineering syllabus, which enables cadets to intend to get the engineering diploma of the École navale;
- Auditor syllabus, which enables cadets to intend to obtain the professional Masters diploma. This concerns cadets who are considered as being qualified for it.

In the framework of their scientific training, cadets who integrate the engineering syllabus attend learning options according to their wishes and academic results.

Cadets from the auditor syllabus attend a joint scientific training that enables them to validate the first semester of the professional Masters.

The training objectives of this semester, mainly dedicated to sciences, are the following ones:

- To develop the acquired scientific knowledge through the choice of 2 options (engineering) ;
- To acquire a basic knowledge in specific scientific fields (auditor) ;
- To approach project management;
- To deepen one's training as an executive of the Nation so as to approach the SIGEM<sup>1</sup>;
- To carry on with the maritime and military training;
- To discover the military sub-sea diving;
- To carry on with the military and physical hardening;
- To acquire the aptitude certificate for supervising a sport session (MAPTISPORT).

## 2. ASSESSMENT

### 2.1. Engineering syllabus

As specified in the exams and studies ruling statement, tests are concentrated on three periods that preferably correspond to the week preceding leaves. This does not exempt from a continuous assessment for some specific subjects.

### 2.2. Auditor syllabus

The regulation of the professional Masters diploma imposes a double control which is both continuous and partial. It also includes a remedial session, planned about one month after the first session.

### 2.3. Planning

In order to balance the training on the whole semester and enable this way cadets to have a regular working rhythm, a standard week system has been adopted. Thus, each week will be generally composed of 30 teaching units of academic courses. Those are normally shared out this way:

- FMI: 18 UI ;
- FHM: 12 UI.

---

<sup>1</sup> Joint military academies seminar, attended at the 4<sup>th</sup> semester.

This standard week is made as follows:

	Monday	Tuesday	Wednesday	Thursday	Friday
H1	OPTION 1	OPTION 1	OPTION 2	OPTION 1	OPTION 2
H2					
H3	Sport	LV1/LV2	FHM	FHM	LV1/LV2
H4					
H5	LVE	LV2/LV1	TP / PROJET	SPORT OPTION	Practical / PROJECT
H6	OPTION 2	FHM			
H7					
H8		SPORT OPTION			

Nota bene: Some adaptations could occur for this sharing-out depending on special circumstances (public holidays, conferences,...).

## TRAINING PROGRAMME OF THE SEMESTER

	Subject	HO	HNO	Coeff.	ECTS
FMI	Scientific options, PIA	216		26	20
FMM	Pre-corvette	35	3		/
	Corvette	70	48	5	
FHM	Opening conferences	5			/
	Conferences of general interest	4			
	Interview with the lieutenant responsible for the squad	11			
	Armed conflicts law	6		2	8
	Organisation of the international society	8			
	English /Second modern language	50		3	
	English CML	5			
	Infantry marches		5		
	Physical hardening training (including shooting)	35	48	8	
	DECPLMIL <sup>2</sup> training period	35			
	School of the soldier	3	10		
	Supervision of 1st-year cadets (Integration period)	15	20		
	Sport by squad	22		2	
	Sport by option	25	24	1	
	Admiral cross-country running	4			
MAPTISPORT training period	35				
Divers	Study	28			/
	Public holidays	7			
	Shifted school start	7			
	Medical examinations (Toulon)	35			
	Supervision of 1st-year cadets (Traditions)	15			
	Ski	14			
	Sailing (JDA start)	4			
	External activities	5			
	Suppleness	35			
TOTAL		734	158	47	28

Nota bene: Coloured modules are also part of the professional masters syllabus.

<sup>2</sup> Introduction to military diving

# TITLE I: Seaman training

## 1. OBJECTIVES

The aim of this training is to keep up and strengthen the knowledge that was acquired at the first semester.

Specific objectives are:

- the acquisition of coastal navigation in a simple situation,
- the introduction to ocean navigation,
- the practice of tactics,
- the performing of manoeuvres.

## 2. CORVETTE

Cadets carry out a two-week corvette at sea. They perform this way at least **16** hours of watch in F1 (function one: officer of the watch in pairs) and also **4** hours of F1 on the simulator. The corvette is carried out by sharing the class in different watches.

The general objectives that are pursued for this initial corvette are as follows:

- navigation/manoeuvre: acquisition of coastal navigation and introduction to ocean navigation – tactics – manoeuvre;
- engineering: propulsion diesel and alternator diesel (preparations before the casting off, steering and monitoring, instructions in the case of damages, decoking rules).

An order of circumstances provides the level hit by the cadets and details the objectives that have to be reached for the corvette.

## 3. PRE-CORVETTE

The corvette is preceded by a pre-corvette of one week.

During this period dedicated to seaman training, cadets are shared out into groups of 3 or 4; the three visual simulator bridges are prepared by three groups. The other groups alternate courses, stretch of water and radar simulator .

Some of the visual simulator slots are planned during non-working hours.

The training objectives on the visual simulator are the following ones:

- point setting up by means of three bearings, acquisition of fairway navigation techniques (lining and constant bearing by the bow and by astern, with and then without drift);
- practice of simple anti-collision manoeuvres;
- use of VHF;
- anchoring;
- emergency reaction to steering damage;
- deck logs keeping.

The objective of the training on the radar simulator consists in a navigation with mist.

The practical training for manoeuvre during this pre-corvette is the following:

PRACTICAL MANŒUVRE							
Code: MANPRAT	Title	UI	Group	Teacher	Stage	Salle	Obs.
6 P3	Sailing course – theory 2 Aerodynamics - Forces	1	Squad	Sailing teacher	Pre- CA1	Lecture hall	
6 P4	Sailing course – theory 3 Adjustments	1	Squad				
6 P5	Sailing course – theory 4 Optimization	1	Squad				
	Stretch of water – Training ship/ VSP/ Sailing	4	Squad	Inst.		PDE	
TOTAL		7					

## TITLE II: Human and military training

In the extension of teaching that is provided during the first year, human and military training is organised at semester 3 and aims at:

- developing personal endurance through a hardening training period, marches and the continuation of sport training;
- reinforcing and measuring the qualities of an officer by giving responsibilities to the midshipmen as far as the supervision of 1<sup>st</sup>-year cadets is concerned.;
- acquiring skills in English or in another modern language;
- opening up cadets on international institutions so as to fully benefit from the Joint seminar for military schools (*SIGEM*).

## MILITARY TRAINING

### 1. OBJECTIVES

In the field of physical hardening, the training which is planned for this semester is composed of:

- a progressive programme of marches on various themes. On the practice programme of semester 2, obstacles are also integrated into the marches base and a plastron is also provided by an external unit to animate a simple tactics theme;
- a training period for physical hardening at the *École militaire spéciale de St Cyr Coëtquidan* or at the *École des fusiliers marins* in Lorient. This training period is based on moving and confrontation with vital problems even if simple. Technical and tactical courses consist in minimum essentials. Strain is due to constant activity and lack of sleep and hardiness is omnipresent because the whole training takes place on the ground in winter.
- a training period for discovering military diving (*DECPLOMIL*<sup>3</sup>) which is organised by modules of 30 cadets. During this compulsory training, five diving sessions (day/night) are proposed to cadets who don't have any contraindications for sport diving. This training period is composed of courses on military diving, security linked with the practice of diving, visits of operational units and sport sessions. It will end with the issue of a training certificate for the functions of OCP (Officer in charge of diving) and with the SSP mention (Diving security supervisor).

### 2. INITIAL PROGRAMME

Three marches at night are organised during the semester. Marches come to an end at the latest on 1.00 am.

As far as the training period for physical hardening is concerned, the class is divided into 4 half-watches: each half-watch will successively perform the physical hardening training either at the ESM of St Cyr Coëtquidan, or at the Ecole des fusiliers marins et commandos of Lorient, whereas other half-watches perform their training period for discovering diving, the MAPTISPORT or medical examinations for aeronautic aptitude in Toulon. The different sessions of the physical hardening training are usually planned around Winter leaves. Training objectives and related difficulties are similar in St Cyr and in Lorient. However, contents are representative of the specific features of each school.

CODE: PRODEF	Course	Concerned teachers	UI	Observations	Group
1P	Training for the parade	DIRASPI	3 HO 10 HNO	For the flag presentation ceremony and 11 November ceremony	Class
2P	Training period for physical hardening	03 Prodef	35 HO 48 HNO	Departure on Monday (by road) and return on Friday evening	Half-watch
3P	March theme 5	04 Prodef	5 HNO	Return before 1.00 am	Class
4P	DECPLOMIL training period		35 HO	Performed in <i>GPD</i>	Half-watch
TOTAL			73 HO 63 HNO		

<sup>3</sup> DECPLOMIL = Discovery of military diving

## PRACTICAL TRAINING TO LEADERSHIP

### 1. OBJECTIVES

Training, which is planned for the semester is dedicated to the implementation of knowledge acquired during the PIRANHA exercise (organised at semester 2). The second-year cadet, as a midshipman, is now able to assure organisation and supervision responsibilities and to conduct simple missions for the school, the class and first-year cadets (who are called *fistots*). He must use methods he learnt so as to plan his action, brief his team and adapt to unexpected events and report on these elements.

Now, he also has to set the example from a behaviour point of view.

### 2. INITIAL PROGRAMME

<b>CODE: FPC</b>	<b>Activities</b>	<b>Concerned teachers</b>	<b>UI</b>	<b>Observations</b>	<b>Group</b>
FPC2	Supervision of <i>fistots</i> (integration period)	DIRASPI	15 HO 20 HNO	At the arrival of first-year cadets	On appointment <sup>4</sup>
FPC3	Supervision of <i>fistots</i> (traditions)	DIRASPI	15 HO	During the traditions week	On appointment
FPC4	Marches preparation	LV PRODEF	4 HNO	For marches	
FPC5	Preparation and supervision of activities of the school	DIRASPI	HNO	For any moving, visit and varied missions as well as team work	
TOTAL			30 HO 24 HNO		

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<sup>4</sup> groups are formed according to scientific options.

## PHYSICAL EDUCATION

This semester is characterized by a **reinforced physical education** by squad, orientated towards physical and sport activities of a military nature (22UI). It is also composed of a physical education by squad (49UI) as well as a training period which provides an aptitude certificate for supervising a basic sport session (MAPTISPORT – 35 UI).

### 1. OBJECTIVES

- To develop physical capacities and especially endurance.
- To develop motor skills that are specific to sport and physical activities that are chosen.
- To get a significant level in a sport activity by means of the sport option training.
- To prepare the *T.S.G.E.D.*
- To prepare competitions that are organised by the French federation for academic sport and also take part in them.
- To get the MAPTISPORT.

### 2. INITIAL PROGRAMME

#### 2.1. Teaching by squad or by group

This teaching is made up of 22 teaching units and is composed of the following kinds of training:

- swimming;
- assault course;
- operational techniques for close intervention (*TIOR*);
- pass'sport tests.

#### 2.2. MAPTISPORT training period

Cadets attend a one-week training period (35 UI HO) which provides the MAPTISPORT certificate.

#### 2.3. Teaching by sport option

Cadets must keep the sport option they attended the previous year.

Sport options are defined at the beginning of the academic year, for example:

- Team physical and sport activities: football, rugby, handball, volley-ball, basketball, sailing;
- Individual physical and sport activities: athletics, cross-country running, orientation running, horse riding, fencing, swimming, badminton, tennis, judo/karate.

Teaching HO/HNO	UI number
Tuesday HNO	24
Thursday HO	25

#### 2.4. Admiral cross-country running

Two admiral cross-country running on the site of the academy are organised during this semester (4UI in total).

**INTERVIEWS WITH THE LVE**

Cadets benefit with their whole squad from an interview with the lieutenant in charge of their education and military training. This corresponds to 11 teaching units (about 1UI/week of presence at the academy). The 3<sup>rd</sup> semester goes on with thought dedicated to the following themes and interviews:

<b>CODE</b>	<b>Presentation</b>	<b>UI</b>
LVE	Command, authority of the chief	6
	Discussion on a current topic	2
	Knowledge of the Navy	3
	<b>TOTAL</b>	<b>11</b>

## PRACTICE OF LANGUAGES: ENGLISH OR SECOND MODERN LANGUAGE

### 1. OBJECTIVES

- To gain autonomy, ease and correction in the practice of this language;
- If possible, to get the English CML2 at the end of the semester (S3) for those who already passed the CML1;
- For cadets who already obtained the English CML2, the objective is to improve their skills related to the practice of a second modern language.

### 2. INITIAL PROGRAMME

Courses dedicated to the teaching of languages represent 50 UI whatever the modern language that is concerned.

#### 2.1. English

According to the results that are obtained for the CML1 during the first year, working groups made of 12 to 15 cadets are formed.

Main subjects of English courses are the following ones:

- written expression;
- oral expression and presentations;
- phonology;
- grammar;

#### 2.2. Second modern language

Cadets who already own the English CML2 attend a course dedicated to another language, that they began to learn before their entry at the academy. They have the choice between:

- German, non beginners;
- Spanish, non beginners;
- Russian (beginners accepted under conditions).

At the beginning of the semester, a test is put in place to check the level of cadets who registered at German or Spanish courses.

### 3. ASSESSMENT

#### 3.1. English

The aim of this assessment is twofold:

- To evaluate the language mastering level in comparison with a given standard (tests shared by all cadets and that assess written comprehension, oral comprehension as well as written expression).
- To measure the knowledge acquired by the cadets and the progress in their results. It means here, to regularly make a balance of the linguistic skills of each cadet, in order to make a comparison with the others. This concerns all the courses and all the different levels of CML that are pursued (a continuous assessment is organised within each level group and deals with expression and comprehension skills).

#### 3.2. Second modern language

To measure the knowledge acquired by the cadets and the progress in their results. It means here, to regularly make a balance of the linguistic skills of each cadet, in order to make a comparison with the others. This concerns all the courses and all the different levels of CML that are pursued (a continuous assessment is organised within each level group and deals with expression and comprehension skills).

### 4. TUTORING

Cadets who did not obtain the CML1 at the end of the second semester are benefiting from a tutoring process. They are strongly encouraged to perform a linguistic stay abroad so as to ensure progress in their results.

**POLITICAL AND SOCIAL SCIENCES: THE ORGANISATION OF THE INTERNATIONAL  
SOCIETY**

1. OBJECTIVES

- To understand how the international society was built;
- To know the United Nations Organization, its role and its functioning;
- To know UNO peacekeeping terms;
- To be aware that there are other protagonists involved in international relations, and especially NGOs.

2. INITIAL PROGRAMME

Test shared with the module dedicated to armed conflicts law: i.e. a total of two teaching units for tests.

CODE: OI	UI	SUBJECT	Teacher	Group
1C	1	<i>International relations: from westphalian system to the crisis of multilateralism.</i> Specific features of the relations between the States. The westphalian system and its limits. League of Nations and UNO, triumph of multilateralism? Consequences of the end of the Cold War on the international system.	Political and social sciences teacher	Squad
2C	2	<i>The UNO: system and main bodies.</i> UNO: an international organisation with a universal mission. Main bodies (especially, the General Assembly, the Secretary Generalship, the Security Council and the International Court of Justice). UNO system: programmes (ex. UNHCR) and connected institutions (ex. IMO).		
3C	2	<i>United nations and peacekeeping.</i> Lessons from the failure of the League of Nations. Charter system and its blocking. Birth of Peacekeeping Operations and their limits. Evolutions of peacekeeping after Cold War.		
4C	1	<i>Other protagonists of the international scene.</i> NGOs and the appearance of international/regional organisations. An heterogeneous whole but negatively defined. NGOs, crises and interferences. A sign of moving back from the Nation-State?		
5D	2	Shared test: international organisation/armed conflicts law	Political and social sciences teacher Company chief	Class
TOTAL	8			

## POLITICAL AND SOCIAL SCIENCES: ARMED CONFLICTS LAW

### 1. OBJECTIVES

- To know the behaviour rules of a soldier.
- To respect humanitarian law rules in action.
- To master the resort to force in accordance with the principles of the Geneva and The Hague conventions.
- To be able to implement and combine main international rights and duties in an operational context of naval war.
- To know how international penal law functions.

### 2. INITIAL PROGRAMME

Joint test for European institutions and organisation of the international society: i.e. a total amount of 2 teaching units of tests.

CODE: DCA	UI	SUBJECT	TEACHERS	GROUP
1C	2	<b>Rules for hostilities conduct:</b> Starting from the projection of the didactic film "Fulfilled mission, respected rights" from the Red Cross International Committee, presentation of Geneva Conventions and account of behaviour rules at war. Notions of combatant, military objective, involvement rules, limitation of harmful means of action and a few elements on disarmament.	Officer from the Naval supply officers school	Class
2C	2	<b>Humanitarian law:</b> Protected people and goods; Protection principle and treatment standards, prisoners of war, international penal law, the Red Cross International Committee.		
3C	2	<b>Maritime war law:</b> Theatre of naval war, exclusion areas matter and rights of neutral countries. Attitude towards merchant ships and treatment of smuggling. Regulations concerning the use of arms and specific means for hostility. Capture and seizure.		
TOTAL	6			

OI 5D	2	Shared test: international organisation/armed conflicts law	Political and social sciences teacher Company chief	
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## Title III: Engineering training

### 1. OBJECTIVES

At the end of semester 2, training is divided into two syllabuses: engineering or auditor.

#### 1.1. Engineering syllabus

This second scientific stage is more in-depth than the core curriculum. It enables cadets to acquire scientific additional information in two different fields thanks to the choice of 2 options. Notions that are taught enable then each cadet to choose and attend a course from one of the different in-depth units (VA) that are proposed during the third stage of the scientific teaching. Each option is the prerequisite of an in-depth unit.

During the second stage, cadet engineers from the *École navale* hit a training stage that enables them to choose the direction of their scientific training. They have to choose 2 options among the following ones:

- waves and signals;
- computer science;
- mechanics;
- energy.

The sharing-out is made according to the cadets wishes and also the necessity to balance the groups. To this aim, it is necessary to repeat twice the courses of an option. Moreover, planning constraints (corvette by watches, supervision of 1st-year cadets...) do not permit to have the same level progression in courses between first-choice option and second-choice option.

#### 1.2. Auditor syllabus

Stages 2 to 4 of the auditor syllabus are part of the programme of the professional Masters «Maritime environment and naval operations» at the *École navale*.

Gathered under the form of course units (UV), this second stage of the scientific training enables the cadets to acquire knowledge in the following fields:

- naval energy;
- naval hydrodynamics;
- digital filters and sea applications;
- geographic information systems.

#### 1.3. Joint training

Both kinds of training are completed by a compulsory module made up of a project dedicated to the introduction to autonomy and also of practical.

### 2. DETAILED TRAINING

#### **Option:**

Each option corresponds to 72 training teaching units being shared out in 3 modules of 24 teaching units. Each module is composed of 22 UI of courses or tutorials, that are subjected to a test (2 UI).

#### **Course unit:**

The training is composed of 8 courses modules that are subjected to a test in continuous assessment and under the form of written exams at the end of the semester.

#### **Project:**

In parallel with options or course units, cadets must conduct a project dedicated to the introduction to autonomy. To this aim, 48 teaching units are planned. The last 6 hours are used for oral presentations.

#### **Practical:**

All cadets perform, alternately with the project, 24 teaching units dedicated to practical. This corresponds to 8 practical of 3 UI. The planning of these practical is subjected to a specific order from the Department for scientific teaching.

# ENGINEER SYLLABUS

## Computer science option

### COMPUTER SCIENCE OPTION – ADVANCED PROGRAMMING: AM1 – EM1

<b>Department:</b> Computer science
<b>Prerequisite courses:</b> TC2
<b>Courses or Modules for which this module is necessary:</b> VA SIM
<b>Number of ECTS credits:</b> 1,5

#### 1. COURSE OBJECTIVE

Extending of programming principles.

##### **Students know-how at the end of the courses:**

Cadets will have acquired the different programming methods (iterative, recursive) and means to manage data files (input and output files). Cadets will know how to manage memory dynamically (pointers) and use more complex storage structures (linked lists, binary trees and n-ary trees).

##### **Connections with other courses:**

This course is the extending of the TC 2 module "Programming and algorithms systems". These principles will be applied within the module "Networks and security". This course brings bases to approach most of the modules from the SIM in-depth unit for which programming is necessary (Object-orientated technology 1 and 2, computer graphics...).

#### 2. DETAILED PROGRAMME

1. Recursion (2h C - 3h TD)
2. Structures and files (2h C - 3h TD)
3. Pointers (2h C - 3h TD)
4. Binary and n-ary trees (2h C - 5h TD)

(\*) The teaching of this module is provided twice in the same way.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Computer
3. 4.	TD	2	Computer
5. 6.	TD - C	2	Computer
7. 8.	C - TD	2	Computer
9. 10.	TD	2	Computer
11. 12.	C	2	Computer
13. 14.	TD	2	Computer
15. 16.	TD - C	2	Computer
17. 18.	C - TD	2	Computer
19. 20.	TD	2	Computer
21. 22.	TD	2	Computer
23. 24.	D	2	Squad
TOTAL		24	

**COMPUTER SCIENCE OPTION – NETWORKS AND SECURITY: AM2 – EM2**

<b>Department:</b> Computer science
<b>Prerequisite courses:</b> TC5
<b>Courses or Modules for which this module is necessary:</b> Computer science in-depth unit
<b>Number of ECTS credits:</b> 1,5

## 1. COURSE OBJECTIVE

Communication between computers. Vocabulary, TCP/IP communication. To understand Internet exchanges functioning and communication protocols between computers.

**Students know-how at the end of the courses:**

At the end of this course, cadets will have acquired the specific vocabulary that will enable them to sustain a conversation with technicians from this field. They will know the functioning principle of the TCP/IP communication layer as well as the principle for exchanging information on several machines. They will also be made aware of the use of Internet and information systems security. They will be then able to understand exchanges that occur on the Internet.

**Connections with other courses:**

This course provides further information to the course dedicated to data architecture.

## 2. DETAILED PROGRAMME

The teaching of this module is provided twice in the same way.

Session n°	Type	Content	UI Nb.	Room
1. 2.	C	Introduction	2	Squad
3. 4.	C	Addressing notion	2	Squad
5. 6.	TD	Network configuration	2	Computer
7. 8. 9. 10.	C	Communication protocols	4	Squad
11. 12. 13. 14. 15. 16.	TD	Protocols manipulation	6	Computer
17. 18.	C	Application to the Internet	2	Squad
19. 20.	TD	Use of the Internet	2	Computer
21. 22.	C	Information systems security	2	Squad
23. 24.	D	Test	2	B016
TOTAL			24	

## COMPUTER SCIENCE OPTION – DATABASES: AM3 – EM3

<b>Department:</b> Computer science
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Computer science in-depth unit
<b>Number of ECTS credits:</b> 1,5

### 1. COURSE OBJECTIVE

Entity-Relationship modelling principles for databases, relational databases, SQL computer language (Structured Query Language) and implementation of these principles in a relational databases layout engine.

#### **Students know-how at the end of the courses:**

This course enables cadets to master basic concepts for setting up and using relational databases. Principles related to information modelling and management can be applied to other scientific fields or any activity that uses information processing.

#### **Connections with other courses:**

This course will enable cadets to grasp the different modules from the SIM in-depth unit that have a direct link with relational databases (ex: Geographic information systems).

### 2. DETAILED PROGRAMME

1. Entity-relationship modelling (4h).
2. Relational principles (3h).
3. SQL, computer language (Structured Query Language) (7 h).
4. Management and transactions (6 h).
5. Object-orientated data bases and advanced databases (2 h).

The teaching of this module is provided twice in the same way.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	TD	2	Squad
5. 6.	C	2	Squad
7. 8.	C	2	Squad
9. 10.	C - TD	2	Computer room
11. 12.	C - TD	2	Computer room
13. 14.	C - TD	2	Computer room
15. 16.	C - TD	2	Computer room
17. 18.	TD	2	Computer room
19. 20.	TD	2	Computer room
21. 22.	TD	2	Computer room
23. 24.	D	2	Squad
TOTAL		24	

## Mechanics option

### MECHANICS OPTION – CONTINUUM MECHANICS: BM1 - FM1

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Maritime engineering in-depth unit
<b>Number of ECTS credits:</b> 1,5

#### 1. GENERAL OBJECTIVE

To provide cadets with notions on mechanics of solids that can be distorted, and particularly concerning constraint and distortion. A large part will be dedicated to elastic environments as well as stresses such as flexion, tension, torsion and compression.

#### Connections with other courses:

This is a course of a general nature which acts as a basis for future officers as far as maintenance techniques are concerned. It constitutes a necessary basis for the Maritime engineering in-depth unit.

#### 2. DETAILED PROGRAMME

1. Conservation laws (4h).
2. Constraints and distortions notions (8h).
3. Behaviour and elasticity laws (6h).
4. Classical problems (6h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	C	2	Squad
7. 8.	TD	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	TD	2	Squad
15. 16.	C	2	Squad
17. 18.	TD	2	Squad
19. 20.	C	2	Squad
21. 22.	C - TD	2	Squad
23. 24.	TD - D	2	Squad - B016
TOTAL		24	

**MECHANICS OPTION - STRUCTURES (RDM<sup>5</sup> - VIBRATIONS) : BM2 - FM2**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> BM1 - FM1
<b>Courses or Modules for which this module is necessary:</b> Maritime engineering in-depth unit
<b>Number of ECTS credits:</b> 1,5

## 1. GENERAL OBJECTIVE

**The course on Strength of materials** represents the application part of the course on mechanics of continuous environments. It approaches screw shaft dimensioning and calculation of bending moment and shear force of a craft subjected to thrust share-out.

The objective of the **course on Vibrations** is to make cadets aware of vibrations problems and consequences on a problem related to structures dimensioning. Modal analysis and resonance phenomena constitute the main part of this module.

**Connections with other courses:**

The course on Vibrations is additional to the one on structures statistics (MMC and strength of materials). The different themes that are used can be applied to any problem dealing with the dynamics of a system.

## 2. DETAILED PROGRAMME

- Strength of materials: Shaft torsion, shear force and bending moment of beams, rivets laying.
- Vibrations: Study of a vibratory system with n degrees of liberty. Modal analysis. Study of continuous structures. Applications.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	C	2	Squad
7. 8.	TD	2	Squad
9. 10.	TD	2	Squad
11. 12.	C	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	C	2	Squad
19. 20.	TD	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	B016
TOTAL		24	

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<sup>5</sup> RDM = Strength of materials

### MECHANICS OPTION – FLUID MECHANICS: BM3 - FM3

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> BM1 - FM1
<b>Courses or Modules for which this module is necessary:</b> Maritime engineering and electric engineering in-depth units
<b>Number of ECTS credits:</b> 1,5

#### 1. GENERAL OBJECTIVE

To provide cadets with basic notions in fluid mechanics. The course is orientated towards the determination of stresses that are carried out by fluids on obstacles.

**Students know-how at the end of the courses:**

Cadets must know fundamental equations of fluid mechanics and be able to lay out, in the framework of a pilot study, stresses on a structure in a fluid outflow.

**Connections with other courses:**

This kind of teaching is additional to the course on continuum mechanics which sets conservation equations of any continuous environment. It is preparatory to the courses that are attended in the framework of GM and GE in-depth units.

#### 2. DETAILED PROGRAMME

1. Introduction and problematics (1h).
2. Equations related to conservation in a fluid (2h). Applications (2h).
3. Stresses on obstacles: theorem of movement quantities (3h). Applications (4h).
4. Stresses on obstacles: empirical approach (2h). Applications (4h).
5. Stresses on obstacles: dimensional analysis, similarities (2h). Applications (2h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	TD	2	Squad
15. 16.	C	2	Squad
17. 18.	TD	2	Squad
19. 20.	TD	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	B016
TOTAL		24	

## Waves and signals option

### WAVES AND SIGNALS OPTION – WAVE PROPAGATION: CM1 – GM1

<b>Department:</b> Signals and Acoustics
<b>Prerequisite courses:</b> TC 8 (Signal processing bases)
<b>Courses or Modules for which this module is necessary:</b> Submarine acoustics in-depth unit
<b>Number of ECTS credits:</b> 1,5

#### 1. GENERAL OBJECTIVE

To understand equations of acoustic and electromagnetic waves, their basic solutions and boundary conditions. To acquire basic knowledge in the field of submarine acoustics propagation.

##### **Students know-how at the end of the courses:**

This teaching must enable cadets to understand the physical phenomena of waves propagation (acoustic and electromagnetic ones). The setting up of equations and their solutions constitute the most important part of the course. Boundary conditions are then detailed. The course finally comes to an end with a study of submarine acoustics waves.

##### **Connections with other courses:**

This course constitutes a prerequisite for the teaching from the submarine acoustics in-depth unit, and especially for the course dedicated to submarine acoustics. Some notions of signal processing are essential (TC8: Signal processing bases).

#### 2. DETAILED PROGRAMME

1. Introduction and general matters
2. Waves propagation equation(s)
3. Energies, intensities and impedance
4. Waves equation solutions
5. Boundary conditions
6. Submarine acoustics propagation

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD	2	Squad
19. 20.	C	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	B016
TOTAL		24	

**WAVES AND SIGNALS OPTION – DIGITAL SIGNAL PROCESSING (TNS) : CM2 – GM2**

<b>Department:</b> Signals and Acoustics
<b>Prerequisite courses:</b> TC 8 (Signal processing bases)
<b>Courses or Modules for which this module is necessary:</b> Submarine acoustics in-depth unit, module on wave propagation (waves and signals option)
<b>Number of ECTS credits:</b> 1,5

## 1. GENERAL OBJECTIVE

Digital signal processing is now considerably opened to consumer applications. CDs, mobile phones, navigation aids... are some of the equipment that integrate techniques issuing from digital signal processing. This is why it constitutes an important theme of the teaching provided in the framework of the Waves and signals option. The objective of this course is to complete bases that have been acquired in the field of signal processing and to provide cadets with a learning on digital signal processing.

**Students know-how at the end of the courses:**

Cadets will have to master classical tools of signal processing. This teaching deals with the transformation of analog signals into digital signals with a presentation of the sampling principle. Concepts that are linked with digital filtering and digital filters synthesis (principles, methods) are also proposed and considerably detailed. This course comes to an end with an introduction to digital communications.

**Connections with other courses:**

This course enables cadets to assimilate the digital signal concepts that are necessary to understand basic techniques used in the field of digital communication (module from the submarine acoustics in-depth unit).

## 2. DETAILED PROGRAMME

1. Digital signal processing problematics
2. Signal sampling
3. Quantization
4. Digital filtering
5. Synthesis of digital filters

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	TD	2	Squad
11. 12.	C	2	Squad
13. 14.	TD	2	Squad
15. 16.	C	2	Squad
17. 18.	C	2	Squad
19. 20.	TD	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	B016
TOTAL		24	

## WAVES AND SIGNALS OPTION - AUTOMATION: CM3 - GM3

<b>Department:</b> Signals and Acoustics
<b>Prerequisite courses:</b> TC 10
<b>Courses or Modules for which this module is necessary:</b> None
<b>Number of ECTS credits:</b> 1,5

### 1. GENERAL OBJECTIVE

Automation aims at analysing, modelling and then commanding systems. In the framework of this course, cadets will be made aware of the different phenomena and the importance of this science through the presentation of many examples: automatic piloting of a ship or a plane, control of computer-operated arms. Basic tools for understanding automation will be taught in this module. The course comes to an end with an introduction to the representation of systems state, that is necessary to understand Kalman filter.

#### **Students know-how at the end of the courses:**

This teaching presents automation bases and especially linear systems. After an introduction to control systems, the Laplace Transform will also be presented. This is a mathematical tool for solving differential equations with constant coefficients, that govern linear systems with automatic control. Cadets will also be introduced to error and sensitivity constants. Speed, stability and correction will be studied.

### 2. DETAILED PROGRAMME

1. Response of a linear system
2. Precision of an automatic control
3. Stability
4. Correctors
5. Representation of states

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	TD	2	Squad
11. 12.	C	2	Squad
13. 14.	TD	2	Squad
15. 16.	C	2	Squad
17. 18.	TD	2	Squad
19. 20.	C	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	B016
TOTAL		24	

# Energy option

## ENERGETICS OPTION - HYDRAULICS: DM1 - HM1

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Energetic engineering and mechanical engineering in-depth units
<b>Number of ECTS credits:</b> 1,5

### 1. GENERAL OBJECTIVE

To provide cadets with notions on incompressible viscous fluids dynamics, to make them answer a problem related to hydraulic installations dimensioning, during a pilot study.

#### Students know-how at the end of the courses:

This teaching deals with fluid flow in pipes. It concerns head losses and the use of Bernoulli's equation, which is extended for the calculation of an hydraulic installation. At the end of this course, cadets must be able to lay out an hydraulic installation (flow, pump...) in the framework of a pilot study.

#### Connections with other courses:

This course is preparatory to the module "Pumps and exchangers" and to the courses attended in the framework of energetic engineering and mechanical engineering in-depth units.

### 2. DETAILED PROGRAMME

1. Introduction (1h).
2. Conservation equations in a fluid environment (3h).
3. Applications to viscous flow in pipes (4h). Practical calculation of head losses (3h).
4. Introduction to hydraulic machines (3h).
5. Applications to pipes calculation (8h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	C	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	C	2	Squad
13. 14.	C	2	Squad
15. 16.	TD	2	Squad
17. 18.	TD	2	Squad
19. 20.	TD	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	Squad
TOTAL		24	

**ENERGETICS OPTION - INTRODUCTION TO HEAT TRANSFERS: DM2 - HM2**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Energetic engineering in-depth unit
<b>Number of ECTS credits:</b> 1,5

## 1. GENERAL OBJECTIVE

Heat transfers by conduction at stationary rate and thermal radiation. This course brings bases in the field of heat transfers by conduction and thermal radiation estimation.

**Students know-how at the end of the courses:**

At the end of the course, cadets must be able to calculate heat transfers in simple practical cases: heat transfers by conduction in blades; thermal radiation (greenhouse effect, radiation in fences).

**Connections with other courses:**

This course acts like an introduction to the courses that are part of the energetic engineering in-depth unit: Advanced heat transfers and Exchangers.

## 2. DETAILED PROGRAMME

1. Heat conduction: Fourier's law, heat propagation, thermal strength, blades (12h).
2. Radiation: laws, black body, transfers between black and grey surfaces (12h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C - TD	2	Squad
11. 12.	TD - C	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD	2	Squad
19. 20.	C	2	Squad
21. 22.	TD	2	Squad
23. 24.	D	2	Squad
TOTAL		24	

**ENERGETICS OPTION – POWER ELECTRONICS: DM3 - HM3**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Energetic engineering in-depth unit
<b>Number of ECTS credits:</b> 1,5

## 1. GENERAL OBJECTIVE

To know the bases of power electronics for embedded equipments functioning.

**Students know-how at the end of the courses:**

To know functioning principles of conversion systems by static means (DC to DC converters - Rectifiers - Inverters).

**Connections with other courses:**

This course is preparatory to the electrical engineering module of the energetic engineering in-depth unit for which it is a prerequisite.

## 2. DETAILED PROGRAMME

1. Switching principles.
2. Components.
3. Direct-direct conversion (Inverters).
4. Alternating-direct conversion (Voltage rectifiers/current commutators).
5. Direct-alternating conversion (Voltage inverters).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	TD	2	Squad
5. 6.	C	2	Squad
7. 8.	TD	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	TD	2	Squad
17. 18.	C	2	Squad
19. 20.	TD	2	Squad
21. 22.	C	2	Squad
23. 24.	D	2	Squad
TOTAL		24	

# AUDITOR SYLLABUS – PROFESSIONAL MASTERS

## PROFESSIONAL MASTERS – DATABASES: M1

<b>Department:</b> Computer science
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Geographic information systems
<b>Number of ECTS credits:</b> 1

### 1. GENERAL OBJECTIVE

Entity-relationship modelling principles for databases, relational databases, SQL computer language (Structured Query Language) and implementation of these principles in a relational databases layout engine.

#### Connections with other courses:

This course will enable cadets to master basic concepts for setting up and using relational databases.

### 2. DETAILED PROGRAMME

1. Entity-relationship modelling (4 h).
2. Relational principles (3h).
3. SQL (9 h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	TD	2	Squad
5. 6.	C	2	Squad
7. 8.	C	2	Squad
9. 10.	TD	2	Computer
11. 12.	TD	2	Computer
13. 14.	TD	2	Computer
15. 16.	TD	2	Computer
17. 18.	D	2	Squad
TOTAL		20	

**PROFESSIONAL MASTERS – FLUID MECHANICS: M2**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> None
<b>Number of ECTS credits:</b> 1

## 1. GENERAL OBJECTIVE

To provide cadets with a basic knowledge in the field of fluid mechanics: statics, kinematics and dynamics elements.

**Students know-how at the end of the courses:**

To have fluid mechanics bases.

**Connections with other courses:**

No specific connections with other courses. This course is an introduction to fluid mechanics.

## 2. DETAILED PROGRAMME

1. Fluid statics.
2. Fluid kinematics elements.
3. Fluid dynamics elements: Euler's theorem, Bernoulli's principle.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

## PROFESSIONAL MASTERS – DIGITAL SIGNAL PROCESSING: M3

<b>Department:</b> Signals and Acoustics
<b>Prerequisite courses:</b> TC 8 (Signal processing bases)
<b>Courses or Modules for which this module is necessary:</b> Sonar – Signals and systems
<b>Number of ECTS credits:</b> 1

### 1. GENERAL OBJECTIVE

To go deeper into signal processing and bring elements that are necessary for understanding the functioning of a sonar. This course will approach signal processing problematics as well as knowledge and use of filters and notions of spectrum analysis.

#### **Students know-how at the end of the courses:**

They must know the theory related to analog-to-digital converters (Shannon, different types of sampling, coding) and especially their impact. Moreover, the Discret Fourier Transform (DFT) and the Fast Fourier Transform (FFT) will be considered as being assimilated (the most important thing is the solving of these transforms). This will provide cadets with an overview of the spectrum analysis (for example) that is necessary to understand a system such as the SONAR.

#### **Connections with other courses:**

The whole course dedicated to submarine acoustics is composed of three parts: signal processing bases (core curriculum), courses on digital signal processing and submarine acoustics during semester 3, and then courses on SONAR as well as signals and systems at semester 4.

### 2. DETAILED PROGRAMME

- Digital signal processing.
- Filtering notions.
- Spectrum analysis.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	C	2	Squad
7. 8.	TD	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C - TD	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

**PROFESSIONAL MASTERS – POWER ELECTRONICS IN NAVAL ENVIRONNEMENT: M4**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> FNE - TC 6
<b>Courses or Modules for which this module is necessary:</b> Electric naval propulsion
<b>Number of ECTS credits:</b> 1

## 1. GENERAL OBJECTIVE

To understand and study power-electronic systems that are aboard military or merchant ships as well as their functioning. Course on power-electronic systems, static converters and their naval applications.

**Students know-how at the end of the courses:**

To know how static conversion systems function (DC to DC converters - Rectifiers - Inverters).

**Connections with other courses:**

This course is part of the courses on Energy conversion and Electric engineering. It is preparatory to the module Electric propulsion which is part of the Masters.

## 2. DETAILED PROGRAMME

1. Switching principles in static converters.
2. Components of power electronics.
3. DC to DC converters.
4. Voltage rectifiers, current commutators.
5. Voltage inverters.
6. Dimmers.
7. Cycloconverters.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

## PROFESSIONAL MASTERS – MECHANICS OF STRUCTURES: M5

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> Notion of general mechanics
<b>Courses or Modules for which this module is necessary:</b> Module “Strength of materials” of the professional masters
<b>Number of ECTS credits:</b> 1

### 1. GENERAL OBJECTIVE

To bring cadets notions of structures calculation and dimensioning. This course deals with the analysis of the behaviour of materials on which stress is applied. Pure shear strains on short parts (pins, rivets etc...) as well as the study of the bending of a beam are approached.

#### **Students know-how at the end of the courses:**

Cadets will have to be able to determine how a structure will react while subjected to small stresses.

#### **Connections with other courses:**

This course is an introduction to the strength of materials. It constitutes a prerequisite of the module «strength and materials» during which simple stresses are approached.

### 2. DETAILED PROGRAMME

1. Notions of constraint, distortion and the factor of safety for concrete.
2. Statically indeterminate systems.
3. Pure shear strain

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

**PROFESSIONAL MASTERS – SUBMARINE ACOUSTICS: M6**

<b>Department:</b> Signals and Acoustics
<b>Prerequisite courses:</b> None
<b>Courses or Modules for which this module is necessary:</b> Sonar – Signals and systems
<b>Number of ECTS credits:</b> 1

## 1. GENERAL OBJECTIVE

To study acoustics law and introduce cadets to problems that are specific to Submarine acoustics. This course aims first at setting out the propagation equation and its free field solutions. Boundary conditions are then analysed before ending with a presentation of propagation in the field of submarine acoustics.

**Students know-how at the end of the courses:**

At the end of the course, all notions that have been studied will be considered as being acquired. Cadets will have to know the specific features of acoustic waves, identify the different types of solutions for the propagation equation and be able to put into practice boundary conditions. They will also have to master calculation linked with sound levels. Finally, concerning the part on propagation in submarine acoustics, they will have to be able to perform a line drawing.

**Connections with other courses:**

The main objective of this course on Submarine acoustics is to study acoustic wave propagation. With the course on digital signal processing, it constitutes a prerequisite for the courses on Sonar and Signals and systems.

## 2. DETAILED PROGRAMME

1. Introduction and general matters (1h).
2. Wave propagation equation (2h).
3. Propagation equation solutions (2h).
4. Energy, intensity, deadening (2h).
5. Boundary conditions (2h).
6. Submarine acoustics propagation (2h).

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	C	2	Squad
7. 8.	TD	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C - TD	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

**PROFESSIONAL MASTERS – STRENGTH OF MATERIALS: M7**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> Notion of general mechanics, inertia calculation
<b>Courses or Modules for which this module is necessary:</b> None
<b>Number of ECTS credits:</b> 1

## 1. GENERAL OBJECTIVE

To provide cadets with notions linked with structures calculation and dimensioning. Pure shear strains on short parts (pins, rivets etc...) will be approached as well as the study of the bending of a beam. Notions on screw shafts dimensioning will also be provided.

**Students know-how at the end of the courses:**

At the end of this course, cadets will be able to lay out parts such as pins, transmission shafts or beams.

**Connections with other courses:**

Continuation of the module «Dimensioning and structures».

## 2. DETAILED PROGRAMME

Bending of beams (shear force and bending moment). Torsion of shafts.

Session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	

**PROFESSIONAL MASTERS – THERMAL MACHINES: M8**

<b>Department:</b> Mechanics - energy
<b>Prerequisite courses:</b> Thermodynamics
<b>Courses or Modules for which this module is necessary:</b> None
<b>Number of ECTS credits:</b> 1

## 1. GENERAL OBJECTIVE

The objective of this course is to provide cadets with basic knowledge in the field of thermal machines that are usually necessary on ships. They have to know their functioning, cycles and methods that enable to calculate their performance, starting from thermodynamics bases (a few reminders will be given in this field). Some methods for approaching real phenomena as well as means for improving machines will be studied.

**Students know-how at the end of the courses:**

To know how main thermal machines function and to be able to work out their results.

**Connections with other courses:**

This course requires a prior teaching or at least reminders in the field of thermodynamics so as to be up to scratch.

## 2. DETAILED PROGRAMME

1. Gas turbins: cycle, efficiency, improvements (4h).
2. Refrigerated machines: cycle, calculation (2h).
3. Production of freshwater: cycle, calculation (2h).
4. Diesel engine: cycle, efficiency, improvements (6h).
5. Steam-powered turbins: cycle, efficiency, improvements (4h).

session n°	Type	UI Nb.	Room(s)
1. 2.	C	2	Squad
3. 4.	C	2	Squad
5. 6.	TD	2	Squad
7. 8.	C	2	Squad
9. 10.	C	2	Squad
11. 12.	TD	2	Squad
13. 14.	C	2	Squad
15. 16.	C	2	Squad
17. 18.	TD - D	2	Squad
TOTAL		18	