

**DEVELOPMENT OF GEO-INFORMATICS IN CHILE :**  
**ENGINEERING COURSE AT**  
**THE MILITARY POLYTECHNIC ACADEMY OF THE ARMY OF CHILE**  
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**ABSTRACT :**

A major contribution to the field of geographic and spatial information technology has been made by the 'Military Polytechnic Academy', a further education and training establishment managed by the Army of Chile, in the form of the five-year degree course in military engineering. The alternatives within this course for specializing in specific areas include the specialization of Geo-Informatics. Some course elements are shared with the other military engineering course specializations, others cover all the fundamental aspects of geographic information technology. This training contributes to the consolidation of knowledge about this field among Chilean engineers and to the integration of that expertise into practical real-world applications.

**INTRODUCTION**

Since 1926, the Military Polytechnic Academy of the Army of Chile has been running courses for qualifying professionals as Military Engineer, and although the academic level of those who qualify from the Military Polytechnic Academy is little known, it is similar to or above that given in the major universities in Chile and abroad. This is clear when one reviews the results of the postgraduate projects carried out by those who qualify from this academy at Polytechnic level as Military Engineering Officers and their professional accomplishments both in the armed forces and in civilian entities after leaving the Army.

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Photo N° 1 Entrance to the Military Polytechnic Academy of the Army of Chile  
Fuente: [www.acapomil.cl](http://www.acapomil.cl)

The Chilean law known as Law N° 18.962 "Orgánica Constitucional de la Enseñanza" (Institutional Definition of the Educational Structure) of the Republic of Chile, states that the certificates granted at this Academy are equivalent, for all legal purposes to the Civil Engineering degrees granted by the Universities of Chile.

This situation makes it possible for the participating officers to obtain their degree certificate in military engineering sciences once they finish their studies. With this academic qualification, the Military Engineering Officer is able, both in academic and legal terms, to undertake postgraduate courses at Master's or Doctorate level in Chilean and foreign Universities.

Working for military institutions, Military Engineering Officers perform a major role in the various assignments they take on. In whichever of the various activities requiring their participation, they apply their concept of efficiency in technological and management fields, as seen through a wide and well-informed engineering viewpoint and aiming to fulfil the needs, mainly, of the Army of Chile.

In order to fulfil the objectives and the requirements of the above-mentioned areas, it is judged that the specialized training should be about arms systems, the study and analysis of terrain, communications systems, management of Armed Forces resources, information technology and other aspects. For this reason the current options for specialization available with the Military Engineering course are as follows :

**- Military Engineering : Arms Systems**

- Mechanics
- Chemistry
- Electronics

**- Military Engineering : Systems**

- Geo-information technology

- Communications.

## **- Military Engineering for Defence Resources Management**

### **ACADEMIC DEGREES AND CERTIFICATES GRANTED**

Finishing ten terms of studies, the participants receive their certificate in Military Engineering Sciences. Once their thesis project has been presented and passed, they receive the title of Military Engineer (Polytechnic level) along with one of the above-mentioned specializations. This degree is recognized by the Ministry of Education and by the Chilean Engineers Association. Thus the graduates are authorized to undertake post-graduate studies in whichever of the engineering courses are taught in Chile or abroad, to undertake teaching activities, and to work in any area of the engineering profession.

### **MILITARY ENGINEERING : SYSTEMS, SPECIALIZING IN GEO-INFORMATICS**

In 1997 the Military Polytechnic Academy began to modernize its study programs for the various engineering courses being given at this further education establishment. The existing specialization of Geography in Military Engineering was transformed into the course of Military Engineer specializing in Geo-Informatics. This change began with the incorporation of new information technologies into the training of engineers specializing in subjects related to the study of Cartography, Geodesy and Photogrammetry.

The Military Polytechnic Academy has been training engineers for the Army of Chile for over seventy-five years. Its prestige within the military and civil ambits, both at national and international levels, rests on a rigorous academic process in which the scientific method is considered as the rule for studies.

In order to transform the academic course content and structure for the new specialization in Geo-Informatics, international expertise and knowledge in the field was analyzed, moreover the experiences in Chile and the needs of this country were considered. The main objective was to bring the participant to a high professional level in which his training makes it possible for him to adequately serve the Army of Chile and also to work on tasks as adviser in general, especially in those areas which imply the study and/or analysis of geographic scenarios.

The learning process is effected over ten consecutive terms, in which students have to study and pass each separate subject covered in the course. Given the structure of the Military Polytechnic Academy, no option is allowed for repeating any of the subjects in the event of not passing.



Photo Nº 2 Students in the Specialisation of Geo-Informatics  
Source : [www.acapomil.cl](http://www.acapomil.cl)

The main objective of this course of specialization is to train a student over five years up to the level of a professional able to work with basic and specialized concepts from his engineering training; related to mathematics, basic sciences, engineering sciences, systems management and engineering, and matters related to geo-informatics.

In this way it is intended that the graduate have the capability to analyse engineering problems and propose alternatives for their solution, along with a measure of creativity, through the application of engineering criteria based on the quantification and determination of the size and nature of each problem, in order to take decisions, to plan, design, and develop engineering processes involving geographic information, to manage operational systems, and to participate in multidisciplinary scientific-technological research teams.

The teaching process for this specialization is still undergoing implementation, nevertheless with this modernization it is aimed to achieve a "critical mass" of specialists who have the capacity to participate in operational processes involving geo-spatial information and in the performance of various studies and scenario analyses needed for supporting management processes and decision making, all of this backed by a substantial training in basic sciences, engineering sciences, systems technology, and the scientific and technological aspects of Geography and Informatics present in Geo-information systems.

## **COURSE CONTENT AND STRUCTURE**

The structure of the Military Engineering course specializing in Geo-informatics covers fifty-two course elements distributed over the ten terms that the course lasts at the Academy, these subjects being grouped as follows :

### General Plan :

The General Plan covers all those subjects which are required for and shared by all the specialization courses within the terms of the Military Engineering degree. These mainly cover subjects in mathematics, basic sciences and some applied subjects in the area of management :

Term	Study Plans for Military Engineering Courses, All Specializations					
	<b>General Plan</b>					
I	Calculus I	General Chemistry	Analytical Geometry	Computing		Physical Education
II	Calculus II	Linear Algebra		General Administration	English : Optional 1	Physical Education
III	Calculus III			General Economics	English : Optional 2	Physical Education
IV			Probability Theory		English : Optional 3	Physical Education
V			Optimization			Physical Education
VI				Economics & Management for Defence Resources		Physical Education
VII			Decision Theory			Physical Education
VIII					Thesis Project	Physical Education
IX			Production and Organization Systems	Project Evaluation	Thesis Project	Physical Education
X				Project Management	Internal Army Relations & Reporting	Physical Education

Table N° 1 "General Plan"

### Systems Study Plan :

This plan covers the topics aimed at training in systems, providing the methodological tools needed essentially for the capability to set up multi-disciplinary engineering tools :

Subjects Shared between Arms, Communications and GeoInformatics Courses				
Term				
III	Mechanical Physics	Graphic Design		
IV	Electromagnetic Physics			

V	Differential Equations	Electronics		
VI	Numeric Calculus	Statistics	Micro-Economics	Optimization
VII				Stochastic Processes
VIII			Accounting	Decision Theory
			Finances	
			Project Evaluation	Production & Organisation Systems
			Project Management	

**Table N° 2 : Systems Study Plan - Shared for all Specializations**

### Geo-Informatics Plan :

This plan covers all the subjects aimed specifically at the specialization of Geo-Informatics. For this it includes contents related to information technologies and traditional geographic sciences:

Term	Geo-Informatics Systems					
III	Operating Systems	Computer Architecture				
IV	Data Structures	Topography	Spherical Trigonometry			
V	Programming Languages			Rational Mechanics		
VI	Data Base Systems		Differential Geometry	Compensation Calculus	Photogrammetry I	
VII	Information Systems	Mathematical Geodesy	Geography		Photogrammetry II	
VIII	Data Communication	Graphic Computing		Physical Geodesy	Cartography I	Environment
IX		Image Processing	Spatial Geodesy		Cartography II	
X	Geographic Information Systems					Military Terrain Analysis

**Table N° 3 “Geo-Informatics Study Plan”**

In the structure of the course plans detailed above, the contents of the different subject elements are all interrelated according to the initial analysis made by experts and pedagogical advisers at the Military Polytechnic Academy. For this reason each subject element has to be passed in order to continue to the subsequent elements. As has been mentioned before, the reigning academic system does not allow for repeats and delays in the student's progress through the course sequence. This means a substantial commitment from the students to study and a high standard of teaching from the Academic staff.

The learning process in the course culminates in the performance of a thesis project and document in which each student has to show, by means of a substantial piece of work which usually has potential for practical application, that he possesses the conditions and capabilities necessary for performing real projects involving geographic information. This is carried out over the last three terms that the course at the Academy lasts, simultaneously with the other studies.

## **THESIS PROJECTS PERFORMED**

Some of the chosen matters worked on in the year 2000 as thesis topics are the following :

- Cartographic corrections for geographic and orthometric altitudes measured with GPS systems
- Adaptation of the software developed in Chile called "ORCA" (Orthophoto & Cartography) for it's military use.
- Cartographic Information System for the management of military infrastructure
- Evaluation of the AUPOL system (Police Systems Automation) for the Chilean Police Force, to be applied in police units around Chile

Besides the above, the Military Polytechnic Academy publishes a scientific bulletin which provides summaries of the main teaching work carried out by academic staff and students of this Academy.

Further information about this Academy can be found in the Web page [www.acapomil.cl](http://www.acapomil.cl).

## **BIBLIOGRAPHY**

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**Militar Polytechnic Academy, [www.acapomil.cl](http://www.acapomil.cl)**