



**Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa**

UNIVERSITAT POLITÈCNICA DE CATALUNYA

Polytechnic University of Catalonia (UPC)

Terrassa School of Industrial, Aerospace and Audiovisual Engineering

(ESEIAAT)

Study and design of the control system of an inverted pendulum

Final Degree Project – Budget

Bachelor's Degree in Aerospace Technology Engineering

Author: Erik Martínez Ramírez

Director: Joseba Quevedo Casin

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Contents

Contents	ii
List of tables	iii
1. Budget	1
1.1 Direct costs	1
1.2 Indirect costs	1
1.3 Total costs	2

List of tables

Table 1 <i>Engineering work cost</i>	1
Table 2 <i>Software licenses cost</i>	1
Table 3 <i>Total cost of the study</i>	2

1. Budget

This document presents the estimated Budget of the Study and design of the control system of an inverted pendulum.

1.1. Direct costs

The study has been developed by one engineer along a quarter of four months, being completed in exactly seventeen weeks. The average wage of an undergraduate engineer is assumed to be 10€/hour. Table 1 illustrates the hours of engineering work required to develop the study and its cost.

Concept	Time (h)	Price (€/h)	Cost (€)
Introduction	15	10	150
State of the art	20	10	200
Characteristics of the inverted pendulum	20	10	200
Linearization of the system	30	10	300
State observer design	55	10	550
PID controller design	75	10	750
Laboratory tests	10	10	100
Report	60	10	600
Presentation	20	10	200
Worked hours	305	10	3050

Table 1 Engineering work cost

1.2. Indirect costs

The laptop used to develop the project had a cost of 400€. Assuming a 100% of annual amortization and the period of seventeen weeks that the project lasted, the laptop cost can be estimated with:

$$Cost = 400 \cdot \frac{17}{52} = 130.77€$$

The cost of the software used can be found in Table 2.

Concept	Cost (€)
MATLAB	500
Microsoft Office	80
Software total	580

Table 2 Software licenses cost

The cost of the electricity used will not be considered because of being small compared to the rest of the costs. However, the renting of the laboratory can be calculated as follows, assuming 25€/hour:

$$Cost = 10 \cdot 25 = 250€$$

1.3. Total costs

An overhead of 15% has been applied to the engineering work cost; no overhead has been applied to the rest of costs. The total cost of the study can be found in Table 3.

Concept	Cost (€)
Worked hours cost	3050.00
Overhead (15%)	457.50
Amortization	130.77
Cost of licenses	580.00
Laboratory renting	250.00
Total	4468.27

Table 3 Total cost of the study