

Physics lectures: Physics for Mathematicians

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September 5, 2017

Abstract

The goal of this notes is to write a common manuscript for, at least, the first semester of the subject Physics to be delivered in the Bachelor of Mathematics at Universitat Autònoma de Barcelona.

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1 Information for Professors

- Professors in charge of the subject:

Theory	Jorge Segovia	jorge.segonza@gmail.com	+34 635 187048
Problems	Alba Cervera-Lierta	a.cervera.lierta@gmail.com	

- Past professor who can help us organizing the lectures:

Josep Gutiérrez Martínez	josep.gutierrez@salesians.cat	Professor of theory
Sergi Gonzalez-Solis	sgonzalez@ifae.cat	Professor of problems
Oscar Lorente-Espin	Oscar.Lorente@uab.cat	Theory Physics for Chemists

- Coordinators of the Bachelor

Wolfgang Pitsch	Chief coordinator	
Joaquim Martin	gmat@mat.uab.cat	Associate coordinator

- Doubts to solve:

- Who is the professor in charge of the so-called seminars?
- Do we have Tipler's book in Spanish?

2 Information for Students

3 Prerequisites

The subject Physics, to be delivered in the first course of the Bachelor of Mathematics at Universitat Autònoma de Barcelona, has the official code 100090. With 12 ECTS is a 1-year term subject divided in two semesters. The first one is mostly focused on what is called classical mechanics, the second one comprise electromagnetism and special relativity.

The professor in charge of the theory part for the first semester is Jorge Segovia (jorge.segonza@gmail.com / IFAE@UAB) and for the second semester is Joaquim Matias (joaquim.matias@uab.cat / IFAE@UAB). [For explaining the associated problems is not yet clear. However, for the first semester, Alba Cervera Lierta \(a.cervera.lierta@gmail.com / BSC-CNS\) is, for sure, the professor \[missing second semester and people in charge of the seminars\].](#)

Any prior knowledge beyond the level of *Bachillerato* in Mathematics and Physics is not needed. However, it is advisable that the student has some elemental ability in both subjects:

- Mathematics: function theory, derivation, integration and concepts and operations with vectorial quantities and scales.
- Physics: not indispensable since the subject starts from the elemental principles to a zero level. However, students who have followed a course in Physics in *Bachillerato* have an important advantage.

It is advisable for students to take a first look at the books of the bibliography to familiarize themselves with them and get in touch with the topics that will be dealt with, especially in the first part of the course.

Concerning the first part of the course (first semester), it is focused on classical mechanics. The majority of students who have received a training in Physics in the *Bachillerato* will be familiar with this part. Therefore, our main concern here will be to increase the rigor of the concepts that we are going to see:

Introduction. Units systems. Kinematic particular cases of movement. Concept of relative movement. Dynamical laws of Newton. Inertial and non-inertial reference systems. Forces and moments. Work and kinetic energy. Conservative forces and potential energy. Mechanical energy and conservation theorem. Simple, dampened, forced harmonic oscillators, forced in 1-dimension. Movement in 2 or 3 dimensions. Introduction to vector analysis. Central forces Gravitation Kepler Laws. Newton's universal law of gravitation. Particle systems. Mass center Collisions Solid and Fluid Mechanics. Waves on a rope. Rotating reference systems. The Coriolis theorem.

In the second part, the objective is to present the laws that govern the electrical and magnetic fields, using some of the concepts introduced in the first part. Finally, the third major topic of this course is (special) relativity. This is new material for all students and therefore, there is no prior knowledge required, in addition to the concepts of inertial reference systems and transformations of Galileo that are dealt with in the first part of the course.

3.1 Main goal

Someone could have asked the question: why does a mathematician need to learn a basic course of physics? Usually, are physicists that need mathematics in order to describe the way in which Nature is working. This is because the language for science is mathematics and thus the only way of speaking science is writing in mathematics. However, from my point of view, mathematics reach its total powerful when it is applied to human deaylife more than one uses it for abstract concepts. Examples are: data science, investments and stocks, consulting... The most easy way of applying mathematics to real life problems for an undergraduate student is Physics and that is why this course appear natural here.

While it is true that Mathematics are more necessary for those who want to approach Physics that is the other way round, there is no doubt that Physics is a very important test ground for mathematicians. Not only to enrich and test mathematical concepts from a practical but also epistemological point of view. That is why it is so important that future graduates in Mathematics have a training in Physics.

3.2 Skills

- Faced with real situations with a mean level of complexity, ask for and analyze relevant data and information, propose and validate models using appropriate mathematical tools to finally obtain conclusions.
- Develop a thought and a critical reasoning and to know how to communicate effectively, both in their own languages and in a third language.
- Distinguish, in the face of a problem or situation, what is substantial from what is purely casual or circumstantial.
- Demonstrate to possess and understand knowledge in a study area that is based on the general secondary education base, and is usually found on a level that, while supported by advanced textbooks, also includes some aspects which involve knowledge from the forefront of their field of study.
- Know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of work or study.
- Have the ability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant issues of a social, scientific or ethical nature.
- Recognize the presence of Mathematics in other disciplines.

3.3 Learning outcomes

- Understand basic physical phenomena.
- Develop a critical thinking and reasoning and know how to communicate effectively, both in their own languages and in a third language.

- Formulate and address physical problems, identifying relevant physical principles and using estimates of order of magnitude and special limit cases to arrive at a solution that must be presented outlining suppositions and approximations.
- Introduce yourself to the fundamentals of Physics, including classical mechanics, electromagnetism and relativity.
- Demonstrate to possess and understand knowledge in a study area that is based on the general secondary education base, and is usually found on a level that, while supported by advanced textbooks, also includes some aspects which involve knowledge from the forefront of their field of study.
- Know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of work or study.
- That students have the ability to gather and interpret relevant data (usually within their area of study) to issue judgments that reflect on relevant issues of a social, scientific or ethical nature.
- Use mathematics to describe the physical world, selecting the appropriate equations, constructing suitable models, interpreting mathematical results and comparing them critically with experimentation and observation

3.4 Methodology

Two types of teaching methodology are presented in this subject: one for the theoretical part and the other for problems.

The theoretical part of the subject will be organized in master classes. They will be dynamic with a double objective: i) present, discuss and demonstrate in detail the subject and ii) ask students about their previous knowledge and about their progress in the subject. This will be particularly important for a first-year subject, taking into account the wide sample of students who have different levels of knowledge.

The practical part of the course will be structured in the classes of problems and seminars. During the seminars, organized in small groups of students (one third of the total), the students will work alone or in small groups of 2 or 3 students and will face the proposed problems by consulting the bibliography and the notes of the theoretical classes. The teacher will have an active and individualized role, as far as possible, to see which are the most important conceptual difficulties encountered by students. During the seminar, when considered necessary, some smaller simple problems will also be presented that exemplify some of the aspects that have been presented to the theory class. In the lectures of problems, the most complex and important problems that have been proposed will be solved in detail, emphasizing the relevant theoretical aspects. These training activities are complemented by a series of high-level problems that will be proposed to solve by the student. He/she will deliver one of them in pre-established dates. The objective of these problems will be to make a personal in-depth analysis of some of the most relevant aspects of the subject presented.

3.5 Evaluation

The score of the course will be composed during the first semester by 70% with the score of exam(s) (one or more) and 30% in the continuous evaluation (delivery of problems, problems made in class, etc.). In the second semester, the same rule will be followed, 70% with the exam(s) and 30% with the continuous evaluation focused on the delivery of proposed problems. The final grade will be the average of both notes for each semester. The *Matriculas de honor* will be awarded in terms of this final note (without waiting for the 2nd opportunity exam). The 2nd opportunity exam consists of two parts (one per semester). Both parts must be done if the two semesters are suspend or just the part corresponding with the failed semester. The average in the latter case will be between the note of the approved semester and the note from the part of the 2nd opportunity exam (if approved).

3.6 Bibliography

1. P.A. Tipler, G. Mosca. Física para la Ciencia y la Tecnología (vol. I and II). Ed. Reverté, 6a. edició, Barcelona, 2010.
2. H. Young, R. Freedman, Física universitaria (vol. I and II), Addison-Wesley, Pearson Education, Decimosegunda edición, México 2009.
3. E. Massó, Curs de relativitat especial, Universitat Autònoma de Barcelona. Servei de Publicacions, ed.(06/1998), Idioma: Català, ISBN: 8449012848, Barcelona 1998.
4. A.P. French. Relatividad Especial. Ed. Reverté, 1974.

Note that volumes I and II are appropriate for the first and second semester, respectively.

FACULTAT DE CIÈNCIES
 CALENDARI ACADÈMIC MARC CURS 2017-2018
 (aprovat per la Comissió d'Afers Acadèmics i d'Avaluació de la Facultat de Ciències el 15 de maig de 2017)
Consulteu calendari de les titulacions



Activitats i avaluacions acadèmiques
 Propedèutics voluntaris per als alumnes de nou accés (4 al 8 de setembre)
 Dies festius
 No lectiu
 Proves accés a la Universitat
 Avaluació i activitats de compensació (graus i màsters)
 Portes obertes

SETEMBRE(2017)

DL	DT	DC	DJ	DV	DS	DM
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OCTUBRE

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NOVEMBRE

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FEBRER

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MARÇ

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JUNY

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JULIOL

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SETEMBRE

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23	24	25	26	27	28	29
30						



Actes de Sant Albert: 15 de novembre 2017 (s'aturen les classes de 12 a 14 hores)



Festa Major de la UAB: 9 de novembre de 2017, s'aturen les classes a les 13h.



Festa de la Facultat: 7 de desembre de 2017



Inici de curs i acollida estudiants de primer : 12 de setembre 2017



Obertura Guies docents 07/05/2018 // Dat límit publicació graus 12/07/2018 , màsters 07/09/2018
 Data límit publicació de fe d'errades a guies docents 22/02/2019



Període hàbil sense activitats formatives



Últim dia d'entrada de qualificacions:

Dia de 23 febrer de 2018 a les 20 hores

Dia 12 de juliol de 2018 a les 20 hores

Dia 14 de setembre de 2018 a les 20 hores per a pràcticums i treballs de fi d'estudis

100087	FVR	Funcions de Variable Real
100088	Alg	Àlgebra lineal
100090	Fis	Física
100091	EIM	Eines informàtiques per a les matemàtiques
100089	FM	Fonaments de les matemàtiques
100092	TCA	Temes de Ciència Actual (veure horari específic)

Hores	Teoria		PAUL (Pb)		PLAB (Pr)		SESP (Se)	
	Grups	Hores	Grups	Hores	Grups	Hores	Grups	
60	2	30	2	-	-	16	4	
60	2	30	2	-	-	16	4	
60	1	30	1	-	-	16	3	
20	2	-	-	46	4	-	-	
40	2	30	2	-	-	12	4	

Pb Pràctiques Aula
 Pr Pràctiques Laboratori
 Aula PC
 Se Seminaris

	11-Sep	12-Sep	13-Sep	14-Sep	15-Sep
9-10		Acogida	Alg	FM	Fis
10-11			TCA	Fis	FVR
11-12			TCA	Fis Pb1	FVR Pb1
12-13					Alg Pb2
13-14					FM Pb2
14-15			Fira Entitats		FM Pb2
15-16					
16-17					
17-18					
18-19					
19-20					

	18-Sep	19-Sep	20-Sep	21-Sep	22-Sep
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	TCA	Fis	FVR
11-12	FVR Pb2	Alg Pb1	EIM Pb3	TCA	Fis Pb1
12-13	FM Pb1	EIM Pb4	EIM Pb3	EIM Pb2	FM Pb2
13-14	FM Pb1	EIM Pb4	FM Pb2	EIM Pb2	FM Pb2
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					

	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep
9-10		FVR	Alg	FM	Fis
10-11		FM	FM SeA	TCA	Fis
11-12		EIM Pb3	FM SeA	TCA	Fis Pb1
12-13		EIM Pb3	EIM Pb4	FM SeD	EIM Pb2
13-14		FVR Pb2	EIM Pb4	FM SeD	EIM Pb2
14-15					
15-16			FM SeC		
16-17			FM SeC		
17-18					
18-19					
19-20					

	2-Oct	3-Oct	4-Oct	5-Oct	6-Oct
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FVR SeA	TCA	Fis
11-12	FVR Pb2	Alg Pb1	EIM Pb3	FVR SeA	TCA
12-13	FM Pb1	FVR SeC	EIM Pb4	EIM Pb3	FVR SeD
13-14	FM Pb1	FVR SeC	EIM Pb4	FVR SeD	EIM Pb2
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					

	9-Oct	10-Oct	11-Oct	12-Oct	13-Oct
9-10	Alg	FVR	Alg		
10-11	FM	FM	Alg SeA	TCA	
11-12	FVR Pb2	Alg Pb1	Fis	Alg SeA	TCA
12-13	FM Pb1	Fis Pb1			
13-14	FM Pb1				
14-15					
15-16	Alg SeB	Alg SeD	Alg SeC		
16-17	Alg SeB	Alg SeD	Alg SeC		
17-18					
18-19					
19-20					

	16-Oct	17-Oct	18-Oct	19-Oct	20-Oct
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FM SeA	TCA	Fis
11-12	FVR Pb2	Alg Pb1	EIM Pb3	FM SeA	TCA
12-13	FM Pb1	FM SeC	EIM Pb4	EIM Pb3	FM SeD
13-14	FM Pb1	FM SeC	EIM Pb4	EIM Pb2	FM Pb2
14-15					
15-16	Fis SeB	Fis SeD		Fis SeC	
16-17	Fis SeB	Fis SeD		Fis SeC	
17-18					
18-19					
19-20					

	23-Oct	24-Oct	25-Oct	26-Oct	27-Oct
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FVR SeA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FVR SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FVR SeC EIM Pb4	EIM Pb3		FVR SeD EIM Pb2	FM Pb2 FVR SeB EIM Pb1
13-14	FM Pb1 FVR SeC EIM Pb4	FVR Pb1		FVR SeD EIM Pb2	FM Pb2 FVR SeB EIM Pb1
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					

	30-Oct	31-Oct	1-Nov	2-Nov	3-Nov
9-10	Alg	FVR		Parciales	Parciales
10-11	FM	FM			
11-12	FVR Pb2 Alg Pb1				
12-13	FM Pb1				
13-14	FM Pb1	Alg			
14-15					
15-16					
16-17					
17-18					
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19-20					

	6-Nov	7-Nov	8-Nov	9-Nov	10-Nov
9-10	Parciales	Parciales	Parciales	FM	Fis
10-11				Fis	FVR
11-12				Fis Pb1	FVR Pb1 Alg Pb2
12-13					FM Pb2
13-14					FM Pb2
14-15					
15-16					
16-17					
17-18					
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	13-Nov	14-Nov	15-Nov	16-Nov	17-Nov
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FM SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FM SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FM SeC EIM Pb4	EIM Pb3	SANT ALBERT	FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
13-14	FM Pb1 FM SeC EIM Pb4	FM Pb2		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
14-15					
15-16	Fis SeB	Fis SeD		Fis SeC	
16-17	Fis SeB	Fis SeD		Fis SeC	
17-18					
18-19					
19-20					

	20-Nov	21-Nov	22-Nov	23-Nov	24-Nov
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FVR SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FVR SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FVR SeC EIM Pb4	EIM Pb3		FVR SeD EIM Pb2	FM Pb2 FVR SeB EIM Pb1
13-14	FM Pb1 FVR SeC EIM Pb4	FM Pb1		FVR SeD EIM Pb2	FM Pb2 FVR SeB EIM Pb1
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					

	27-Nov	28-Nov	29-Nov	30-Nov	1-Dec
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FM SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FM SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FM SeC EIM Pb4	EIM Pb3		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
13-14	FM Pb1 FM SeC EIM Pb4	FM Pb1		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
14-15					
15-16	Fis SeB	Fis SeD		Fis SeC	
16-17	Fis SeB	Fis SeD		Fis SeC	
17-18					
18-19					
19-20					

	4-Dec	5-Dec	6-Dec	7-Dec	8-Dec
9-10	Alg	FVR	FESTIU	FESTIU	FESTIU
10-11	FM	FM			
11-12	FVR Pb2 Alg Pb1				
12-13	FM Pb1				
13-14	FM Pb1	Alg Pb1 Alg Pb2			
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					

	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	Alg SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	Alg SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FM SeC	Alg SeC EIM Pb4	EIM Pb3	Alg SeD EIM Pb2	FM Pb2 Alg SeB EIM Pb1
13-14	FM Pb1 FM SeC	Alg SeC EIM Pb4	Fis	Alg SeD EIM Pb2	FM Pb2 Alg SeB EIM Pb1
14-15					
15-16					
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17-18					
18-19					
19-20					

	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec
9-10	Alg	FVR	Alg	FM	Fis
10-11	FM	FM	FM SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FM SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FM SeC	EIM Pb3 EIM Pb4		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
13-14	FM Pb1 FM SeC	Alg EIM Pb4		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
14-15					
15-16	Fis SeB	Fis SeD		Fis SeC	
16-17	Fis SeB	Fis SeD		Fis SeC	
17-18					
18-19					
19-20					

	8-Jan	9-Jan	10-Jan	11-Jan	12-Jan
9-10	Alg	FVR	Alg		Fis
10-11	FM	FM	FM SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	FM SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 FM SeC	EIM Pb3 EIM Pb4		FM SeD EIM Pb2	FM Pb2 FM SeB EIM Pb1
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15-16					
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18-19					
19-20					

	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan
9-10	Alg	FVR	Alg		Fis
10-11	FM	FVR	Alg SeA TCA	Fis	FVR
11-12	FVR Pb2 Alg Pb1	EIM Pb3	Alg SeA TCA	Fis Pb1	FVR Pb1 Alg Pb2
12-13	FM Pb1 Alg SeC	EIM Pb3 EIM Pb4		Alg SeD EIM Pb2	FM Pb2 Alg SeB EIM Pb1
13-14	FM Pb1 Alg SeC	EIM Pb3 EIM Pb4		Alg SeD EIM Pb2	FM Pb2 Alg SeB EIM Pb1
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	22-Jan	23-Jan	24-Jan	25-Jan	26-Jan
9-10					
10-11					
11-12					
12-13					
13-14	Avaluació i activitats de compensació (graus i màsters)				
14-15					
15-16					
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17-18					
18-19					
19-20					

	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb
9-10					
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12-13					
13-14	Avaluació i activitats de compensació (graus i màsters)				
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	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb
9-10					
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13-14	Avaluació i activitats de compensació (graus i màsters)				
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