

Electrodynamics and Synchrotron Radiation

Code: 100173
ECTS Credits: 6

Degree	Type	Year	Semester
2500097 Physics	OT	4	1

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Teachers

Fernando López Aguilar

Prerequisites

None, but it is recommended to have done previously all the Electromagnetism and Mathematics courses.

Objectives and Contextualisation

There are two parts. First part is the lagrangian and hamiltonian formulation of Classical Electrodynamics. Second part is an introduction to radiation by relativistic particles.

Competences

- Apply fundamental principles to the qualitative and quantitative study of various specific areas in physics
- Be familiar with the bases of certain advanced topics, including current developments on the parameters of physics that one could subsequently develop more fully
- Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Generate innovative and competitive proposals for research and professional activities.

- Know the fundamentals of the main areas of physics and understand them
- Respect the diversity and plurality of ideas, people and situations
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project

Learning Outcomes

1. Calculate Lagrangean-conserved quantities with relativistic scalar and vector fields.
2. Calculate the power radiated by accelerated relativistic particles.
3. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
4. Correctly use linear and tensor algebra in non-Euclidean spaces.
5. Describe field effects in load movement.
6. Describe how Maxwell's equations are obtained from first principles such as relativity and the principle of least action.
7. Describe the importance of gauge invariance in electrodynamics.
8. Describe the production of radiation through relativistic particles.
9. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
10. Develop independent learning strategies.
11. Distinguish between the assumptions implicit in a given problem and the consequences of eliminating these and, therefore, learning to generalize solutions.
12. Generate innovative and competitive proposals for research and professional activities.
13. Handle and solve partial differential equations.
14. Illustrate, in other scientific fields, the applicability of the methodology developed.
15. Obtain the equations of motion and evolution for interacting relativistic particles.
16. Pose and solve the equation of motion for a load in certain simple electromagnetic fields.
17. Recognise the importance of gauge invariance in formulating the standard model of fundamental interactions.
18. Recognise the theoretical foundations underpinning the operation of particle accelerators and radiation production.
19. Recognise the theoretical foundations underpinning the quantum theory of radiation.
20. Respect diversity in ideas, people and situations.
21. Use approximate methods to decouple the evolution of complex systems into simpler parts.
22. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
23. Use group theory in describing symmetries.
24. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.
25. Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals

Content

Special relativity. Lagrangian and Hamiltonian formulation of Classical Electrodynamics. Radiation by relativistic particles. Synchrotron Radiation.

Methodology

Theory and problem classes. Two problem deliveries included in qualification in case of improvement.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory and Problem Classes	49	1.96	2, 1, 3, 5, 6, 8, 7, 10, 9, 11, 25, 12, 14, 13, 15, 16, 22, 18, 19, 17, 20, 24, 4, 23, 21
Type: Autonomous			
Individual Work	92	3.68	2, 1, 3, 5, 6, 8, 7, 10, 9, 11, 25, 12, 14, 13, 15, 16, 18, 19, 17, 20, 4, 23, 21

Assessment

Two examinations (with part of theory and part of problems) and two exercises deliveries. Each examination counts up to 50% of final qualification (40% if resolution of delivered exercises is adequate). Mean value will be made if qualification of each examination plus corresponding delivery is at least 3.5 (maximum 10). Final examination allows recovery of non successful examinations. Exercises deliveries are not taken into account in this final examination.

Participation in final examination requires previous participation in both partials. No minimum qualification in partials is needed to participate in the final examination.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final examination	100%	3	0.12	1, 3, 5, 6, 7, 10, 9, 11, 25, 12, 14, 13, 15, 16, 17, 20, 4, 23
First partial	40-50%	3	0.12	2, 1, 3, 5, 6, 8, 7, 10, 9, 11, 25, 12, 14, 13, 15, 16, 22, 18, 19, 17, 20, 24, 4, 23, 21
Problem Delivery	20%	0	0	2, 1, 5, 6, 8, 7, 9, 25, 16, 19, 17, 24, 21
Second partial	40-50%	3	0.12	2, 1, 3, 5, 8, 10, 9, 11, 25, 12, 14, 13, 15, 16, 22, 18, 19, 17, 20, 24, 21

Bibliography

J.D. Jackson Classical Electrodynamics John Wiley & Sons

L.D. Landau , E. M. Lifshitz Classical Theory of Fields Pergamon Press