UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics and Physics Teaching

2627-3-G8501R017-G8501R017M

Course title

Physics and Physics Teaching, with Laboratory

Topics and course structure

The course is composed as follows:

49 hours of classroom lesson

7 hours of exercise (3 shifts of 2 hours one, in small groups and 1 hour all together, with the introduction to PhET interactive simulations, Colorado University, Boulder (USA)).

12 hours of laboratory.

Laboratory is mandatory for all students. Class attendance (for lessons and exercises) is not mandatory, but it is recommended. The material on the platform and the texts in the bibliography will be sufficient to be prepared for the exam,but certainly participating in classroom lessons is an important resource for the understanding of the students as well as collaboration between participants during work sessions. The course focuses on topics such as:
(1) knowledge of some basic physical quantities and Cartesian graphical representations;
(2) what a measurement is and how it is obtained;
(3) water/float;
(4) motion;
(5) explorations of forces (such as friction, electric and magnetic forces);
(6) matter, its constituents, hints at radioactivity;
(7) light, shadows and color;
(8) astronomy (within the laboratory).

In the last part of the course, reference is made to research in physics education with a focus on the most reknown methodologies (such as Inquiry Based Scientific Education, 5E learning cycle, Problem Based Learning).
Multidisciplinary topics will be described (for example art and physics, and energy/sustainibility and physics), also in relationship with some objectives of the UN Agenda 2030 (like Goals 4 and 5, with speeches to the UN by some ambassadors, and short videos on famous female scientists, with a particular focus on gender inclusivity).

The course language is Italian

Objectives

The main objective of the course is to equip the future teachers with skills that will enable them to introduce physics at the primary school in an adequate and respectful way to children.
The course explores, in particular, the topics: forces (friction, weight, electrical and magnetic), light, shadows and color, motion, water/float, and basic astronomy. For each topic, we propose a reflection on the fundamental contents and learning pathways designed to build basic physical knowledge and ways of exploring the natural world proper to this scientific discipline. It proposes a systematic reflection on educational choices regarding contents, approaches, spaces and materials adopted, in order to take into account the motivations underlying such choices.
It is therefore required:

1. Knowledge of the basic content related to the experiences children in a preschool or primary class in relation to the topics covered; knowledge of procedures for measuring quantities (weight p, volume V, space s, and time t); meaning and expression of Archimedes' law; use of the graphical representation in the (V,p) plane to determine the specific gravity of a material and find the buoyancy conditions and the (s,t) representation to describe motion.
2. Understanding the methods of experimental sciences, with particular reference to the relationship between observation (in natural or controlled situations), description (with different languages), construction of interpretative models and theories.
3. Skills in the design of teaching activities and educational path aimed at the interpretation of some physical phenomena.
4. During the laboratory, through observation, description and representation of celestial phenomena, we want to answer the questions: how can we agree what we observe with what we know about the sky and celestial bodies? Understanding and using the "parallel globe".

As per the Regulations and cds Tuning Matrix, the course pursues the following educational objectives:

1. Knowledge of foundational science concepts, selected on the basis of their relevance and accessibility in the preschool and elementary school context.
2. Knowledge of formalized languages and their use to represent and construct models of relationships between objects and events.
3. Knowledge of mathematical structures and conscious use of hypothetico-deductive argumentation.
4. Knowledge of scientific ways of proceeding for the observation, understanding and study of natural phenomena and their interdependent relationships.
5. Basic knowledge and understanding of some chemical, physical and biological aspects in everyday life
6. To use theoretical knowledge and operational tools related to the techniques of observation and reflection to understand the characteristics of the school context, subjects and their relationships, as well as teaching action

To pursue the following skills:

1. To know how to communicate and operate with formalized meanings and languages. Know how to use such languages to represent and construct models of relationships between objects and events.

2. To know how to use the analytical tools of mathematics and physics for scientific description of the world and to deal with problems in everyday life.
3. Know how to apply scientific practices to the study and understanding of natural phenomena: observe, experiment, collect data, imagine, build interpretive models, predict, review.
4. Know how to design teaching activities and pathways through an interconnected view of scientific disciplines in order to interpret phenomena and events systemically.
5. To know how to recognize and approach the cultural assets of the heritage in which one lives (understood in the broadest sense), as well as the heritages of other civilizations, grasping their educational potential.

Methodologies

The teaching involves:
(1) 24 lectures of 2 hours and 1 lecture of 1 hour, conducted in mainly in-presence delivered didactics, with moments of interactive teaching (Wooclap/quiz) and dialogic lecture;
(2) 3 2-hour and 1 1-hour tutorial, conducted mainly in interactive in-presence mode, with group work ;
(3) 3 laboratories of 4 hours, conducted mainly in the in-presence delivery mode, with moments of interactive mode, dialogic lecture and with group work.

For each topic, we propose a reflection on the fundamental contents and learning paths aimed at building basic physical knowledge and ways of exploring the natural world of this scientific discipline. A systematic reflection is proposed on the didactic choices concerning contents, approaches, spaces and materials adopted, in order to become aware of the motivations underlying these choices. The approach to the scientific study of each theme will be phenomenological, to allow the reconstruction of the fundamental game between experience, language, representative knowledge. We start from observing reality to ask ourselves cognitive problems that must appear to students understandable, interesting and not insurmountable and placed in terms that are part of their language, close to their experience. Starting from the use of tools, representations and models, students will have the opportunity to experience the knowledge building process directly. In particular, they will confront themselves, actively and personally, with what it means to observe, describe and interpret a natural phenomenon.
Teaching will be both traditional (face-to-face and laboratory, with a bottom-up approach, large and small group discussions, interactive questionnaires and quizzes, always trying to put the student at the centre of teaching.

Online and offline teaching materials

The main source on which to study is the course e-learning page. The instructor provides additional and alternative materials to support nontraditional students in studying and preparing for the exam (the course lectures, pdf files, full recordings of in-person lectures; recordings of asynchronous lectures; supplementary slides; and background materials such as journal articles, bibliography, and sitography)

Programme and references

For the program see "objectives".

For Erasmus students, a reduced programme can be defined.
For the references: The main source on which to study is the e-learning page of the course, on which lessons, notes, videos, in-depth materials, and everything the student needs to study will be uploaded.

In addition to the material on the elearning page, the following texts are suggested:

“Metodi e strumenti per l'insegnamento e l'apprendimento della Fisica” M.Gagliardi, E. Giordano (a cura di), Edises ed, Napoli.

“Guardare per sistemi, guardare per variabili” di M. Arcà e P. Guidoni (nella sezione materiali). In particolare, i capitoli 1 e 3 per la parte generale e il capitolo 4 per il galleggiamento.

"Insegnare e apprendere fisica nella scuola dell’infanzia e primaria" Matteo Leone, Mondadori

Assessment methods

The student's learning outcomes are assessed through an individual test.
During the course, one partial written test will be proposed (comprising closed-ended tests, short essays and simple problems and exercises) and an oral test (optional or upon request of the teacher). The subject of the test will be the content proposed in the course and in the pedagogical teaching laboratory, in line with the expected results described above.

For those who do not take the in itinere tests, written examinations will be proposed (always with closed-response tests, short essays and simple problems and exercises), with a possible oral test (optional, or upon request of the teacher focussed on discussion of the written paper and of the topics covered in the lecture).

The oral examination will generally be optional, but suggested to students who the lecturer feels can best demonstrate understanding of a topic that was not developed during the written examination. The examination is aimed at understanding the real comprehension of the topics covered, the ability to reason and to be able to express and justify one's statements.

Erasmus students can take the exam in English.
Further info are available in the italian pages and in the regulation of the course (available in the e-learning webpages).

Office hours

By appointment (via email).

Programme validity

The programs last one academic year.

Course tutors and assistants

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Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | INDUSTRY, INNOVATION AND INFRASTRUCTURE