Academic subject: Complements of General Physics				
Degree Class: LM-40 - Matematica		**Degree Course:** Mathematics	**Academic Year:** 2017/2018	
		Kind of class: Mandatory	**Year:** 1	**Period:** 2
			ECTS: 7 divided into **ECTS lessons:** 5 **ECTS exe/lab/tutor:** 2	
Time management, hours, in–class study hours, out–of–class study hours lesson: 40 exe/lab/tutor: 16 in–class study: 56 out–of–class study: 119				
Language: Italian	**Compulsory Attendance:** no			
Subject Teacher: Marcello Abbrescia	**Tel:** +39 080 5443143 **e–mail:** marcello.abbrescia@uniba.it	**Office:** Department of Physics Room R29, Ground Floor	**Office days and hours:** every day, previous appointment via e-mail	
Prerequisites: Knowledge in general physics which are generally learned during the physics courses in the first two years of a degree in a L-35 class in Physics or Mathematics. In particular knowledge about mechanics, electrostatics and magnetostatics.				
Educational objectives: Learning the basics notions in electromagnetism, electromagnetic waves and physical optics. In addition learning the basics principle in special relativity.				
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding:** Learning the basics of electromagnetism, electromagnetic waves, physical optics and special relativity. Learning how to critically put in relation different fields of physics. **Applying knowledge and understanding:** What has been learned can be applied in a great variety of practical physics situations, from electronics to astrophysics. **Making judgements:** Capability to evaluate the scientific coherence of the line of logic reasoning used to describe a physics phenomenon. Capability to choose the right tools and techniques suitable for the analysis of physics systems. **Communication:** Learning the appropriate scientific language and formalism necessary to read and understand physics textbooks, to explain the acquired knowledge, and to describe, analyze and solve problems. **Lifelong learning skills:** Acquiring suitable learning methods, supported by text consultation and by solving the exercises and questions periodically suggested during the course.			

Course program

1. **Electromagnetic induction:** Review about the fundamental laws of electrostatics and magnetostatics. Faraday's law. Lenz's law. Origin of the induced electromagnetic force. Induction phenomena on moving electric circuits: Lorentz's force, rod moving onto rails, coil in a translatory motion in a uniform field, coil in rotation in a uniform and constant magnetic field. Faraday's law in differential form. Betatron. Mutual induction. Mention of reciprocity of mutual induction. Self-induction. Inductive phenomena in electric circuits. Evaluation of the self-induction coefficient; infinite solenoid, toroidal solenoid, parallel wires, coaxial cable. Basics of circuit analysis in non-stationary conditions. Analysis of RC and RLC circuits.

2. **Energy associated to electric currents:** energy flows in inductive circuits. Energy localization in the magnetic field. Basics of magnetic energy between two electric interacting coils.

3. Maxwell's equations: Extension of the Ampere's theorem in dynamic situations: displacement current. Fundamental equations of electromagnetism.

4. Electromagnetic waves: Equations for electromagnetic waves. E and B fields in a plane wave. Basics about plane waves in space. Energy transported by electromagnetic waves. Poynting vector. Sinusoidal plane waves. Spherical and cylindrical waves. Momentum transported by an electromagnetic wave. Radiation pressure. Spectrum of electromagnetic waves.

5. Reflection and refraction of plane waves: Concept of light ray. Laws of reflection and refraction. Huygens's principle and laws of reflection and refraction. Total reflection. Fermat's principle and laws of reflection and refraction. Displacement produced by a glass planar layer.

6. Optics and Maxwell's equations: Equations of electromagnetic waves in presence of homogenous linear materials. Reflection and refraction of electromagnetic plane waves.

7. Interference and diffraction: General concepts on interference. Interference produced by two coherent sources. Coherent sources. Young's device. Interference produced by thin layers, interference produced by N coherent sources. General concepts about diffraction. Fraunhofer's diffraction produced by a slit. Fraunhofer's diffraction produced by a circular fenditure. Resolving power of a circular fenditure. Basics about diffraction gratings.

8. Principles of special relativity: Introduction to Lorentz's transformations. Galilei's transformations. Galileian relativity and Maxwell's equations. A relativity principle only for mechanics? Interferometers and ether dragging. Basics about aberration of starlight. Einstein's relativity principle. A simple example of Lorentz's tranformation. Lorentz's boosts. Matrix formalism and Minkowski metrics. Relativistic cynematics. Length contraction. Time dilatation and proper time. Relativistic composition of velocities. Velocity and acceleration four-vectors. Momentum and wave four-vectors. Energy in special relativity.

Teaching methods:
Lectures and exercise sessions.

Auxiliary teaching:
Slides presented during lectures.

Assessment methods:
Oral exam.

Bibliography:

M.T.Chiaradia, L. Guerriero, G. Selvaggi: “*Fisica II: elettromagnetismo*”, Editrice Adriatica.
M.T.Chiaradia, L. Guerriero, G. Selvaggi: “*Fisica II: onde elettromagnetiche*”, Editrice Adriatica.
M. Gasperini, *Manuale di relatività ristretta*, Springer
It also suitable for consultation:
Halliday-Resnick-Krane: “*Fisica 2*”, Casa Editrice Ambrosiana, fifth edition