Advanced Physics

Academic Year: (2022 / 2023) **Review date: 16-06-2021**

Department assigned to the subject: Physics Department

Coordinating teacher: LOPEZ MARTINEZ, FERNANDO

Type: Electives ECTS Credits : 3.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

PHYSICS

OBJECTIVES

Students should acquire the fundamentals of Applied Optics and different skills and abilities in this area.
Understanding these basics will allow them in turn to acquire the skills necessary to apply the optical models to simple problems resolution. In particular, those corresponding to wave optics, geometrical optics and quantum optics (light as photons accumulation).
At the completion of this topic, students must understand the basic phenomena involved in the interaction of light and matter, their dependence on the wavelength and the properties involved in the generation, transmission and detection of light. Also students must understand the basics of the huge number of applications based on optics and photonics. 3D vision, micro and nano technologies in optics, infrared vision, remote sensing, scientific understanding of global warming,...
Finally, after acquiring a well-founded basic knowledge, the students also acquire the ability of understanding and using future developments and further applications arising in the changing world of Photonics.

DESCRIPTION OF CONTENTS: PROGRAMME

I. WAVE OPTICS
1.1 Introduction to wave optics
- Nature of light. Electromagnetic Spectrum (EM)
- Wave parameters. Energy and Intensity. Poynting`s vector
- The Wave Equation of the EM Field. Solutions
- Propagation of light in free media
- Introduction to wave phenomena

1.2 Superposition of light waves. Interference
- Equal and Different Wavelength.
- Phase and group velocity. Beats.
- Standing waves
- Coherence in Wave Optics. Spatial and Temporal
- Constructive and Destructive Interference
- Contrast, Visibility.
- Interference by wave front division. Young's slit
- Interference by amplitude division. Thin films.

II. Light-Matter Interaction. Applications
2.1 Light-Matter Interaction.
Macro interaction. Diffraction. Fraunhofer and Fresnel diffraction. Resolving power of optical Instruments. Rayleigh criterion.
Classic EM interaction. Light generation by oscillating electrons. The oscillating dipole. The Lorentz model. Emission, absorption, reflection, refraction, scattering, luminescence. The complex refractive index. The dispersion of light. Optical materials.

2.2 Planck's Law.
The limitations of classical Electromagnetism and Thermodynamics: The ultraviolet catastrophe.
- The Black Body radiation. Planck´s Law: the birthday of Quantum Mechanics. Grey and spectral emitters.
- Applications of Planck's Law. Infrared remote sensing

LEARNING ACTIVITIES AND METHODOLOGY

-In the lectures the theoretical concepts previously described, will be discussed.
- Given the advanced nature of the subject, when methodologically appropriate, problems solving and questions, similar to those of the exams, in order to:
Identify the more important Optics and the light-matter interaction laws involved. Analyze the logic of the result obtained: orders of magnitude, relate the most important conclusions to other scientific and technological subjects involved in advanced optics
- Tutorial sessions will be schedule throughout the course, available to students at will. These sessions must be requested in advance

ASSESSMENT SYSTEM

REGULAR EVALUATION WILL BE DONE BY MEANS OF 2 EXAMS, ONE FOR EACH PART. A MAXIMUM OF 50 POINTS WILL CORRESPOND TO THESE 2 EXAMS ALL TOGETHER. A PART OF THESE POINTS CAN BE OBTAINED BY MEANS OF EXERCISES OR OTHER COMPLEMENTARY ACTIVITIES.
THE REST OF 50 POINTS MAXIMUM WILL BE OBTAINED IN THE FINAL EXAM AT THE END OF THE SEMESTER.
FOR PASSING, A FINAL MARK OF 50 POINTS AT LEAST, WILL BE NECESSARY

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- E. HECHT, A. ZAJAC OPTICS, Addison Wesley, ultima disponible

ADDITIONAL BIBLIOGRAPHY

- GUENTHER, R. Modern Optics, J. Wiley & Sons, N.Y., Más reciente disponible

- R. P. Feynman. The Feynman Lectures on Physics, Millenium Edition. Basic Books, 2010