COURSE MODULE ï APPLIED OPTICS & PHOTONICS

COURSE CODE	COSI AOP
COURSE LEVEL	Master
ECTS CREDITS	5
COURSE INSTRUCTOR/S	Prof. Youcef Ouerdane and Prof. Nathalie Destouches (UJM)
EDUCATION PERIOD	SEMESTER 1
EXPECTED PRIOR-KNOWLEDGE	under-graduated course of Physics (such as waves and electromagnetism), under-graduate course of mathematics (elementary algebra and calculus).
LANGUAGE OF INSTRUCTION	English

AIM

This course develops an understanding of the basic elements of Optics and Photonics focused on light models and properties (geometrical, electromagnetic, polarization and basic-quantum), propagation of light (rays), classical interaction of light with matter (reflection, refraction, absorption, scattering, chromatic dispersion), classical interaction of light with light (interferences, diffraction).

On completion of this course the students will be able to:

- Åknow basic optical phenomena involved in the generation of color of objects from a physical point of view.
- Åunderstand the fundamentals and the basic tools which explain these phenomena.
- Åuse the basic techniques involved in the geometrical theory of imaging systems.
- Åhave a clear idea of the influence of aberrations and diffraction in the quality of images.

To develop their analytical skills, students have to study or to work, and report on practical tasks. For practical works, students will perform lab-sessions in direct correlation with the lectures to highlight and ôhand-touchô the optical specifications of optical devices.

TEACHING ACTIVITIES

This course is based on flip-teaching, exchanges and discussions between students and instructors, lectures and practical session activities, as well as homework.

COURSE OUTLINE

(topic 1) Introduction: Overview of light models: geometrical, electromagnetic and quantum. Basic concepts: refraction index, ray and optical length. Light propagation: rays in homogenous and heterogeneous media. Reflection and refraction laws.

(topic 2) Fundamentals of Electromagnetic Optics: Electromagnetic waves characteristics. Electromagnetic spectrum. Plane and spherical waves. Intensity. Coherence.

(*topic 3*) Polarization: Unpolarized, partially polarized and polarized lights. Types of polarized light: linear, circular and elliptical. Polarizers. Half- and quarter-wave plates

(*topic 4*) Classical interaction of light with matter: Absorption. Chromatic dispersion. Scattering.

(*topic 5*) Interferences and diffraction: Double-slit Young's experiment. Multiple-wave interferences. Difraction phenomena. Huygens-Fresnel Principle. Fresnel and Fraunhofer diffraction. Fraunhofer diffraction through different apertures: rectangular and circular apertures. Diffraction gratings.

(*topic 6*) Imaging systems: Paraxial Optics. Principal planes and points. Focal planes and points. Spherical refractive surface. Mirrors. Prisms. Thin lenses. Thick lenses. Basic optical instruments.

(*topic 7*) Quantum Optics: Photons. Basic processes between energy levels: absorption, spontaneous emission and stimulated emission.

PRACTICAL ACTIVITIES

Practical works (laboratory sessions) in order to understand/deepen principles introduced in the lectures, to practice on real applications and to train students.

LEARNING OUTCOMES[1]

ÅKnowledge and *Comprehension* of the basics introduced in this course and how and why they have been implemented in some applications;
Å*Application*, *Analysis*, *Synthesis* and *Evaluation* skills of the main concepts introduced in this course;
ÅAbility to apply/implement principles introduced in the lectures on practical tasks

FORM/S OF ASSESSMENT

Written exam (25%), Practical works (50%), Acquired skills (25%)

ASSESSMENT CRITERION

Written exam and Practical works

Excellent - outstanding performance	A
Very Good - above the average standard but with some errors	B
Good - generally sound work with a number of notable errors	C
Satisfactory - fair but with significant shortcomings	D
Sufficient - performance meets the minimum criteria	E
Fail - some more work required before the credit can be awarded	FX
Fail - considerable further work is required	F

Detail of criteria used to assess acquired skills :
ÅActivities and questionnaires giving evidence of knowing (5%)
ÅActivities and questionnaires giving evidence of comprehension/understanding (5%)
ÅActivities and questionnaires giving evidence of analysis (5%)
ÅActivities and questionnaires giving evidence of synthesis (5%)
ÅActivities and questionnaires giving evidence of evaluation (5%)

Excellent	A
Very Good - above the average standard	B
Good - generally sound well	C
Satisfactory - but with significant shortcomings	D
Sufficient - performance meets the minimum criteria	E
Fail - some more work required	FX
Fail - considerable further work is required	F

The evaluation of informal learning outcomes will be based on questionnaires and laboratory notebook (self-evaluation, learning diary).

LITERATURE AND STUDY MATERIALS

Å"Optics" E. Hetch. Addisson Wesley 2000.
Å"Fundamentals of Photonics" B.E.A. Saleh and M.C. Teich. Wiley, 1991.

CONTACT DETAILS

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[1] The meaning of *keywords* in italic used to define Learning Outcomes are detailed in Annex.