

Module Outline FYE34

1. GENERAL

SCHOOL	OF SCIENCE AND TECHNOLOGY		
PROGRAMME	Studies in Natural Sciences		
LEVEL OF STUDIES	Level 6 of the Hellenic and European Qualifications Framework		
MODULE CODE	FYE34	YEAR	3d
MODULE TITLE	CLASSICAL PHYSICS II		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		HOURS	CREDITS
Weekly workload: 14 hours x 32 weeks		448 (28hours/ECTS)	16 ECTS
MODULE TYPE <i>Compulsory/Elective/ Mandatory Optional</i>	Compulsory		
MODULE DESCRIPTION <i>general background, special background, specialised, general knowledge, skills development</i>	Scientific area		
PREREQUISITE MODULES	FYE24		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE MODULE OFFERED TO ERASMUS STUDENTS	No		
MODULE WEBSITE (URL)	https://www.eap.gr/en/undergraduate/studies-in-natural-sciences/studies-in-physical-sciences-topics/#fye34 The Module has its own space in the digital learning environment of HOU (https://study.eap.gr/login/index.php) with controlled access (using a code) for students and Teaching Staff.		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the Module are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

LEARNING OUTCOMES

Knowledge:

Upon successful completion of the course, students will be able to:

1. Describe and analyze the theory of coupled oscillations and normal modes.
2. Explain and analyze the fundamental principles of wave physics, including:
 - properties of mechanical and electromagnetic waves,
 - interference and diffraction phenomena,
 - geometrical optics.
3. Formulate and interpret the fundamental principles of the Special Theory of Relativity, including:

- Lorentz transformations,
 - time dilation and length contraction,
 - relativistic momentum and energy,
 - the relativistic Doppler effect.
4. Describe and interpret the basic principles of General Relativity.
 5. Analyze the experimental evidence leading to the development of Quantum Mechanics.
 6. Present and interpret the fundamental concepts of Quantum Mechanics, including:
 - the wavefunction and its probabilistic interpretation,
 - the Schrödinger equation,
 - the uncertainty principle,
 - wave–particle duality.
 7. Analyze the solutions of the Schrödinger equation for fundamental quantum systems (infinite well, potential step, harmonic oscillator, Coulomb potential).
 8. Compare and interpret Maxwell–Boltzmann, Bose–Einstein, and Fermi–Dirac statistical distributions.
 9. Explain atomic structure, emission and absorption spectra, band theory, and their technological applications.
 10. Describe and analyze key concepts of nuclear and particle physics, including radioactivity, fission, fusion, fundamental interactions, and elementary particles.

Skills:

Upon successful completion of the course, students are expected to:

1. Calculate the frequencies and amplitudes of normal modes in coupled systems.
2. Solve problems in wave physics (interference, diffraction, geometrical optics).
3. Apply Lorentz transformations to physical problems.
4. Compute relativistic quantities (energy, momentum).
5. Solve the Schrödinger equation for simple potentials.
6. Calculate energy eigenvalues and interpret their physical significance.
7. Apply the appropriate statistical distributions to simple thermodynamic or quantum systems.
8. Interpret spectra and energy levels.
9. Solve basic problems involving nuclear decay and nuclear reactions.

Competences:

Upon successful completion of the course, students are expected to:

1. Integrate different theoretical frameworks of physics (classical physics, relativity, quantum theory).
2. Select and justify the appropriate theoretical model for describing a physical phenomenon.
3. Evaluate the limits of validity of a physical theory.
4. Interpret modern technological applications (semiconductors, lasers, nuclear energy) based on fundamental principles.
5. Communicate knowledge of modern physics with clarity.
6. Develop scientific reasoning based on mathematical modelling.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the Module aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

The general skills that the students will acquire are:

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Criticism and self-criticism
Production of free, creative and inductive thinking

3. SYLLABUS

Purpose of Module

The purpose of the Course Module is to provide students with fundamental knowledge concerning:

- coupled oscillations and waves,
- Special Relativity and the principles of General Relativity,
- the principles of Quantum Mechanics and Nuclear Physics, as well as their applications in the interpretation of physical phenomena.

Subjects covered

- Relativity
- From Classical to Quantum Physics
- Oscillations and Waves

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Distance teaching and learning. Students participate in six (6) Group Counseling Meetings (GCMs) of four-hour duration during the academic year, held on weekends. In addition, six (6) supporting GCMs (SGCMs) are conducted on dates determined in consultation with the students. Personal communication and feedback (advisory role of Adjunct Faculty members).												
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	During GCMs and teaching, the following are used: - Remote meeting tools (Webex, Teams), - Presentation software (PowerPoint, educational videos – animations, etc.). In addition, students use office automation tools, web browsers, as well as e-readers for digital books. Communication with students is supported by: - The digital platform of HOU (https://study.eap.gr/login/index.php) (course information, educational material uploads, announcements, messages, examination results, user groups, discussion forums, etc.). - Electronic mail (e-mail).												
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	<table border="1"> <thead> <tr> <th>Activity</th><th>Year Workload</th></tr> </thead> <tbody> <tr> <td>6 GCMs and 6 SGCMs (x 4 hours)</td><td>48</td></tr> <tr> <td>6 Written Assignments (x 10 hours)</td><td>60</td></tr> <tr> <td>Individual Study time (~10.5 hours x 32 weeks)</td><td>334</td></tr> <tr> <td>Final examination</td><td>6</td></tr> <tr> <td>Total Workload</td><td>448</td></tr> </tbody> </table>	Activity	Year Workload	6 GCMs and 6 SGCMs (x 4 hours)	48	6 Written Assignments (x 10 hours)	60	Individual Study time (~10.5 hours x 32 weeks)	334	Final examination	6	Total Workload	448
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STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>Language of evaluation, methods of evaluation, summative or conclusive,</i>	Students' evaluation – Grade assessment of a Module: a. six (6) Semester Assignments (A) which contribute equally to the final grade with a value of 5% each and 30% of the final grade as a total. <i>The scoring of educational activities and assignments is activated only if the student succeeds an overall score equal to or above the base (≥ 5) in the final or repeat exams.</i>												

<i>multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	b. Final or repeat exams (E) contributing to the final grade of the module by 70%. The Final Grade of the module, within scale 1-10 (10 is the excellent), is calculated as follows: Final Grade= (Ax0.3) + (Ex0.7) <u>Language of evaluation:</u> Greek
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5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Young, H., Freedman, R., *University Physics with Modern Physics*. Volume B: Electromagnetism – Optics – Modern Physics, Papazisis Publications, 2022.

Pain, J., *Physics of Vibrations and Waves*, Gutenberg Publications, 2020.

Serway, R.A., Moses, C.J., Moyer, C.A., *Modern Physics*, Crete University Press, 2011.

Hecht, E., *Optics*, translated by I. Spyridelis, S. Spyrideli, A. Kantidou, ESPI Publishing Co., 1979.

-HOU Publications:

Volume A: *Relativity*, Hellenic Open University (HOU), Patras, 1999.

Volume B1: *Oscillations and Waves*, Part A, Hellenic Open University (HOU), Patras, 2005.

Volume B2: *Oscillations and Waves*, Part B, Hellenic Open University (HOU), Patras, 2005.

Kouris, S., *Alternative Teaching Material for the Course Module “Classical Physics II” – Hypertext: Oscillations and Waves*, Hellenic Open University (HOU), Patras, 2005.

Additional supplementary digital (including multimedia) material is available on the study platform (study).

- Related academic journals:

Journal of Applied Physics

Applied Physics Letters

Journal of Materials Science: Materials in Electronics

Physical Review B

Journal of the Optical Society of America B: Optical Physics

Classical and Quantum Gravity

Journal of Cosmology and Astroparticle Physics

Physical Review D – Particles, Fields, Gravitation and Cosmology