INTRODUCTION TO PLASMA ENGINEERING

COURSE OUTLINE

Responsible: Ioannis Fytilis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Electronic Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	8000.1.008.0	**SEMESTER**	Winter/Spring
COURSE TITLE	Introduction to Plasma Engineering		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	4
Total	**3**	**4**

COURSE TYPE general background, special background, specialised general knowledge, skills development	Specialization course
PREREQUISITE COURSES	Basic knowledge of electromagnetism and optics (Lorentz force, e/m waves formalism, Maxwell equations, dielectric\magnetic constant, refractive index, refraction, etc.)
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Both Winter and Spring Semesters
COURSE WEBSITE (URL)	https://eclass.hmu.gr/courses/EE344/

2. LEARNING OUTCOMES

Learning outcomes

The course introduces the students to the fundamental of plasma and the applications of plasma technology. After completing the course, the student will be able to:

- understand the plasma phase of the matter, the unique properties it has and the different types of plasmas.
- calculate/evaluate basic plasma parameters
- mention the different formulations of plasma description and where could be applied
- recognize the different type of waves that could develop/propagate in plasmas and their properties
- have knowledge of the different technologies of plasma sources and their properties
- describe various plasma applications and choose the proper plasma sources
- use proper diagnostics for plasma sources characterization
- mention and describe the various type of dense plasma generators and their applications.

General Competences

Decision-making, Independent work, Exercising criticism and self-criticismm Generating new research ideas, Promoting free, creative and inductive thinking

3. SYLLABUS

- Introduction to plasma: definitions, properties, Debye shielding, temperatures- densities, types of plasmas, plasma frequency.
- Plasma descriptions: particle motion, kinetic description, two-fluid description, magneto-hydrodynamic (MHD) description, ideal-MHD, plasma conductivity.
- Waves in plasma: waves in non-magnetized plasma, phase velocity, refractive index, critical density. Waves in magnetized plasma, cutoff-resonance, MHD waves.
- Plasma sources: electric discharge tubes, plasma torch, corona discharge, Dielectric Barrier discharge, RF discharge, Microwave discharge. Electron beam plasmas. Laser plasmas.
- Plasma applications: Material processing, nanolithography, plasma antennas, plasma monitor, plasma thrusters, spectroscopy, sterilization.
- Plasma diagnostics: diagnostics of magnetic field, current, particle flow, refractive index, spectroscopy. Diagnostics with X-rays, ion beam.
- Dense plasma & applications: pulsed power plasma devices. Z-pinch, plasma instabilities, X-pinch & other pinch configurations, Dense Plasma Focus, Tokamak, Stellarator. high photon energy sources, particle acceleration, fusion energy.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Face-to-face theoretical teaching. Problem solving.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	Use of slide presentation software. Electronic communication with students
TEACHING METHODS The manner and methods of teaching are described in detail.	

Activity	Semester workload
Lectures	36
Problem Solving	10
Personal study	52
Short project	20
Examination	2
Course total	**120**

STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	Written exams 40%, exercises-questionnaires 30%, short project presentation 30%.

5. ATTACHED BIBLIOGRAPHY

1. Introduction to Plasma Technology: Science, Engineering and Applications, J.E. Harry, 2010, Wiley?VCH, ISBN Print:9783527327638 Online:9783527632169
2. Plasma Physics and Engineering, A. Fridman, L.A. Kennedy, 2011, CRC Press, ISBN 9781439812280
3. Plasma Engineering: Applications from Aerospace to Bio and Nanotechnology, 1st edition (or 2nd edition), M. Keidar , I. Beilis, 2013 (2018), Academic Press, ISBN: 978-0123859778 (978-0128137024)
4. Principles of Plasma Physics for Engineers and Scientists, U.S. Inan, M. Golkowski, 2011, Cambridge University Press, ISBN 13:9780521193726