UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Plasma Physics I

2526-1-F1703Q036

Aims

Aims

Teaching the principles of plasma physics: relevant thermonuclear fusion issues, astrophysics, ionosphere and plasma applications:

Kinetic and fluid models for plasmas and applications to the study of wave–plasma interaction in natural and laboratory plasmas.

Magnetohydrodynamic (MHD) equations for the analysis of the stability of magnetized plasmas and MHD instabilities in linear and toroidal plasmas.

Overview of descriptive models of plasmas generated for applications (gas-phase and surface-phase kinetics, sheaths, and sources).

Contents

Contents

Fundamentals of plasma physics: kinetic and fluid plasma models, wave-plasma interaction by fluid model and kinetic model, magnetohydrodynamic equations, magneto-hydrodynamic stability and instabilities, magnetic reconnection, introduction to plasma applications (plasma sheaths and sources).

Detailed program

Detailed program

Kinetic and fluid descriptions of plasma: The distribution function;
The Vlasov equation and the kinetic description; Landau damping and electrostatic waves within the kinetic framework. Moments of the distribution function;

Derivation of fluid equations;
Waves in plasmas using the multi-fluid description: Waves in an unmagnetized plasma; Langmuir oscillations; Transverse electromagnetic waves; Pressure effects; Waves in a magnetized plasma: perpendicular and parallel propagation; Wave polarization in plasma and Faraday rotation; Waves in a drifting plasma: two-stream instability. Plasma diagnostics using waves.

Derivation of the Magnetohydrodynamic (MHD) equations and ideal MHD; the Reynolds tensor and magnetic field diffusion, magnetic islands and magnetic reconnection. Stability conditions of magnetic configurations.
Description of MHD instabilities: an overview of sausage and kink instabilities; Treatment of the Rayleigh-Taylor instability in fluids and in plasmas.

Plasma applications: Sources, Sheaths, and Plasma Processes.

Prerequisites

None

Teaching form

Frontal lectures (6 ECTS) held in the classroom using the blackboard and the projection of videos and slides, and also delivered remotely in both synchronous and asynchronous (recorded) modes.

During the course, questions, written problems and their solution, and detailed insights on the topics? are also proposed, with the direct participation of the students.

Two hours of lectures are dedicated to presenting the national and international roadmaps for plasma research, the research groups involved, and the opportunities for participating in summer schools.

Textbook and teaching resource

Reference books:

R. Dandy. Introduction to Plasma Physisc

R .J. Goldston, Introduction to Plasma Physics

M. A. Liebermann, Principles of plasma discharges and material processing, Wiley Interscience

Semester

First semester

Assessment method

Oral examination

Mark range: 18–30/30

Questions on the topics covered by the programme plus a subject of the student’s choice

Office hours

On appointment to be arranged by e-mail to claudia.riccardi@unimib.it

p/o

Ed. U2 - Dipartimento di Fisica, Piazza della Scienza 3 - 3 floor, room 3014.

Phone: 0264482314

Email: claudia.riccardi@unimib.it

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY