

Syllabus

I. Course Name: Mathematical Topics in Kinetic Theory

II. Course description and objective

The course is devoted to some models of interaction between the molecules (such as hard or rigid spheres, rough spheres, Maxwell's molecules and so on) and the nonlinear integro-differential kinetic Boltzmann Equation which describes the evolution of rarefied Gas.

III. Elective

IV. Master Program, 2th Term, 64 Class Hours, 3 Credits

V. Course content

Chapter 1. Boltzmann Equation, Maxwellians

Section 1. The topic of kinetic theory

Section 2. History of development of the kinetic theory

Section 3. The main models of interaction between the molecules

Section 4. The distribution function of molecules. Density, temperature, mass velocity

Section 5. The Boltzmann Equation. Maxwell's molecules

Section 6. Some general properties of the Boltzmann Equation

Section 7. Explicit solutions of the Boltzmann Equation - Maxwellians

Section 8. Hydrodynamical parameters of Maxwellians

Section 9. Classification and the physical sense of Maxwellians

Section 10. The motions of a Gas with the constant temperature

Section 11. "Screws" ("spirals"), "eddies", and the "acceleration – compacting"

Chapter 2. Nonequilibrium states, "mixed" residual

Section 1. Nonequilibrium states, TMS - distribution

Section 2. The search of explicit approximate solutions of the Boltzmann Equation

Section 3. Minimization of the "mixed" residual in the one-dimensional case

Section 4. The search of coefficient functions – solution of the system of nonlinear PDF

Section 5. Method of the separation of variables

VI. Pre-taken courses

Mathematical Analysis, Functional Analysis, Ordinary and Partial Differential equations, Distribution Theory.

VII. Form of the final test: examination (four-level evaluation scale)

VIII. Teaching materials and reference books

1. Больцман Л. Лекции по теории газов. – М.: Гостехиздат, 1956.
2. Карлеман Т. Математические задачи кинетической теории газов – М.: ИЛ, 1960.
3. Чепмен С., Каулинг Т. Математическая теория неоднородных газов. – М.: ИЛ, 1960.
4. Коган М. Н. Динамика разреженного газа. – М.: Наука, 1967.
5. Черчиньяни К. Теория и приложения уравнения Больцмана. – М.: Мир, 1978.
6. Петрина Д. Я., Герасименко В.И., Мальшев П. В. Математические основы классической статистической механики. – К.: Наукова думка, 1985.

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