Approved:

Dean:

/ Prof. G. Rainovsky, Dr. Habil. /

Exam Questionnaire

for a candidates for doctoral program
"Plasma and Gas Discharge Physics"
(Regular treining program for PhD)

1. Plasma - definition, types, basic parameters, plasma quasi-neutrality, motion of charged particle in plasma.
2. Electrodynamics of meterials with spatial and temporal dispersion. Initial and boundary problems.
3. Collisions of particles in plasma - types, conservation laws, differential and transport cross sections. Elastic collisions. Change in momentum and energy in collisions.
4. Inelastic collisions. Excitation and deactivation. Ionization and recombination; types of recombination (three-particle, collision-radiative, ion-ion, photorecombination).
5. Structure of a diatomic molecule. Processes involving diatomic molecules in plasma.
6. Motion of charged particles in electric and magnetic fields: drift of charged particles.
7. Kinetic modelling – distribution function, Boltzmann equation, collisional integral.
8. Moments of the distribution function. Momentum equations - fluid models for plasma description.
9. Dielectric permittivity and conductivity of homogeneous isotropic plasma - conclusion based on the fluid model.
10. Transport processes in plasmas without an external magnetic field. Coefficients of mobility, diffusion and thermal conductivity. Ambipolar diffusion.
11. Transport processes in plasmas with an external magnetic field. Coefficients of mobility, diffusion and thermal conductivity across the magnetic field.
12. Waves in an unbounded plasma without an external magnetic field – linear theory based on a fluid plasma model.
13. Positive column of an electric arc at high pressure – quasi-isothermal plasma.
14. Positive column of a glow discharge at low pressure – non-isothermal plasma. Diffusion and free fall regimes.
15. High-frequency capacitive and inductive discharges.
16. Microwave discharges sustained by surface waves.
17. Probe methods for plasma diagnostics - single, double probe.
18. Spectroscopic methods for plasma diagnostics by measuring the intensity of spectral lines and by studying their broadening.

Literature:

1. V. E. Golant, A. P. Zhilinsky and I. E. Sakharov (1977) Fundamentals of plasma physics, Atomizdat, (Moscow).
2. A. F. Alexandrov, L. S. Bogdankevich and A. A. Rukhadze (1988) Basics of plasma electrodynamics, (Moscow).
3. F. Chen (2016) Introduction to Plasma Physics and Controlled Fusion, (Springer).
4. B. M. Smirnov (1978) Physics of weakly ionized gas, Nauka, (Moscow).
5. Ya. P. Raizer (1991) "Gas Discharge Physics" (Springer).

6. M. A. Lieberman and A. J. Lichtenberg (2005) Principles of Plasma Diagnostics and Materials Processing, Wiley, New York.
7. H. R. Griem (1996) Principles of Plasma Spectroscopy, Cambridge Press, Cambridge.

26.07.2023

Head of Department: Stanimir Kolev

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Date: 2023.07.26 11:57:06 +03'00'

Sofia / Assoc. Prof. Dr. St. Kolev /