ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

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Basic Information:
Course Title: Kinds and Features of Gas Discharges used in Lasers
Lecturer: Prof. Dr. Krassimir Angelov Temelkov
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Email: temelkov@issp.bas.bg
Total Teaching Hours: 20 hours of lectures and 5 hours laboratory classes

Annotation (up to 150 words)

Specialized course “Types and Characteristics of Gas Discharges used for Gas-Discharge Lasers Excitation” is addressed to PhD student of laser physics, physical and quantum electronics, physics of atoms, molecules and plasma. The course includes a study on different types of gas discharges and basic processes, taking place in gas-discharge plasma and leading to the creation of the population inversion in different types of metal vapor, noble gas and molecular lasers. Special attention is paid to the methods for measurement and calculations of the interaction cross sections for these processes. Methods for electrical energy deposition in the gas-discharge plasma, using various excitation schemes, are also considered.

Course content (brief description by topics or modules)

Topic / Module 1: Partially ionized gases. Sort of particles. Gas and electron temperatures.

Topic / Module 2: Types of gas discharges, used in lasers. Self-sustained and non-self-sustained gas discharge. Positive coulomb discharge, hollow cathode discharge, radio frequency discharge, longitudinal and transverse pulsed discharge.

Topic / Module 3: Charge exchange processes – basis, experimental determination and theoretical calculation for particular ion MVL, such as Cu, Ag, Hg, Cd, Zn, etc.

Topic / Module 4: Electron excitation, Penning ionization and recombination population. CuBr and $SrBr_2$ vapour lasers and ion Cd and Sr vapour lasers.

Topic / Module 5: Resonant energy transfer between atom-atom and molecule-molecule. He-Ne and CO_2 lasers.

Topic / Module 6: Gas temperature – radial distribution and methods for gas temperature calculation for various tube geometry and gas mixtures.

Topic / Module 7: Experimental determination of electron temperature in gas discharges through method of relative intensities of the spectral lines.

Topic / Module 8: Methods for electrical energy input in the gas-discharge plasma – types of excitation schemes.

Topic / Module 9: Influence of excitation schemes on the processes for the creation of the population inversion.

Teaching and assessment methods
Correspondence (Distance) education and laboratory exercises.

Exam with a grade based on self-prepared essay on one of the specified topics and discussion on all the specified topics.

Competencies acquired as a result of training (3–5 points)

Competence in the types of gas discharges used for excitation of gas-discharge lasers.

Competence in the excitation processes and the creation of the population inversion in gas discharge lasers.

Competence in theoretical and experimental determination of gas and electron temperature of the gas discharge.

Competence in electrical pulsed schemes for excitation of gas discharges.

Literature:

1. I. G. Ivanov, E. L. Latush and M. F. Sem, “Metal Vapour Ion Lasers, England: John Wiley & Sons, 1996.
2. J. B. Hasted, “Physics of atomic collisions”, London: Butterworths, 1964.
3. Y. P. Raizer, “Gas Discharge Physics”, Berlin: Springer-Verlag, 1991.
4. R. E. Olson, F. T. Smith, E. Bauer, 1971, *Appl. Optics*, **10**, p. 1848.
5. A. R. Turner-Smith, J. M. Green, C. E. Webb, 1973, *J. Phys.* ***B***, **6**, p. 114.
6. V. C. Aleinikov, V. V. Ushakov, 1972, *Optika i Spectroskopiya*, **33**, p. 214.
7. H. Hotop and A. Niehaus, 1969, *Z. Physik*., **228**, pp. 68-88.
8. N. Vuchkov, D. Astadjov and N. Sabotinov, 1994, *IEEE Quantum Electronics*, **30(3)**, pp. 750-758.
9. R. C. Reid and T. K. Sherwood, “The properties of gases and liquids”, New York, McGraw-Hill Book Company, 1966.
10. D. G. Loveland, A. F. Zerrouk and C. E. Webb, 1992, *Plasma Sources Sci. Technol.*, **1**, pp. 141-146.

Additional information (optional) (e. g., special requirements, laboratory equipment, prior knowledge)

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