COURSE DESCRIPTION

NAME OF THE COURSE: **Micromechanical piezoelectric systems and sensors for frequency control**	CODE: **MMTN02**	SEMSTER: 1
Type of teaching: **Lectures, seminar and laboratory works**	LESSONS PER WEEK: L-1 h,SW-1 h, LW-2 h	NUMBER OF CREDITS: **5**

LECTURERS:
1. Prof. Ph. D. Todor Todorov, phone: 9652794, email: tst@tu-sofia.bg, Department of Theory of Mechanisms and machines;
2. Assoc. Prof. Ph. D Ventsislav Yantchev, Guest lecturer fro Department of Solid State Electronics, Uppsala University, Sweden, contact information: Uppsala University, Dept. Solid State Electronics, Box 534, 75121 Uppsala, Sweden, E-mail: veya@angstrom.uu.se
3. Assistant, PhD Elitsa Gieva, phone: 029653115, e-mail: gieva@ecad.tu-sofia.bg, Department of Microelectronics, FETT, Technical University of Sofia.

COURSE STATUS IN THE CURRICULUM:
Optional course of the Master in " Microtechnology and nanoengineering" , MSc program.

AIMS AND OBJECTIVES OF THE COURSE:
The course complements the knowledge acquired in the course "Basic principles and application of MEMS". Here, the specific frequency is regarded piezoelectric micro - electromechanical systems with a commercial application in the field of sensors, and optical communications. The laboratory exercises are carried out practical experiments to confirm the theory and identify opportunities for their application. The knowledge and skills will enable students to solve problems concerning the design and application of micro and nanosystems.

DESCRIPTION OF THE COURSE:
The main topic of the lecture is microwave mechanics and its application in treatment of wave signals. Viewed is the use of piezoelectric MEMS management of optical signals . Explained the principles of MEMS -based passive RFID applications in tracking goods and those who identify wireless sensors for industrial needs. Discussed are the current challenges to the MEMS industry related to the possibility of their technological integration with electronic integrated circuits and the creation of new features and applications.

PREREQUISITES:
The course requires students basic training in physics and mathematics. Preliminary expertise in MEMS would be beneficial but not mandatory .

TEACHING METHODS:
Lectures by using visual aids. Laboratory work conducted by modern laboratory stands . Optionally, students develop a project .

METHOD OF ASSESSMENT: The final assessment of the course is calculated by adding together the points : exam (with a weight of 0.8) and evaluation laboratories (by a factor of 0.2) . Thus

evaluated as received basic knowledge and theoretical and experimental skills to apply in practice in research and development of MEMS. Examination paper consists of questions with multiple choice answers and problem solving questions and tasks cover all aspects of the syllabus . Examination work aims to establish the level of basic knowledge of the student, as well as its ability to give meaning to what they have learned and apply it to solve specific tasks.

TEACHING LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Surface Acoustic Wave Devices in Telecommunications, Ken-ya Hashimoto, Springer
2. RF Bulk Acoustic Wave Filters for Communications, Ken-ya Hashimoto, Artech. House
3. G. Piazza et. al., "Piezoelectric aluminum nitride thin films for microelectromechanical systems", MRS Bulettin, Vol 37, pp. 1051-1061 , November 2012
4. Practical MEMS, Ville Kaajakari, Small Gear Publishing
5. V. Plessky, L. Reindl, "Review on SAW RFID Tags", IEEE TUFFC 57(3), pp. 654-668.
6. V. Laude et. al., An introduction to phononic crystals, http://www.femto-st.fr/en/Popularization/An-introduction-to-phononic-crystals
7. M. Gedge and M. Hill, "Acoustofluidics 17: Theory and applications of surface acoustic wave devices for particle manipulation", Lab Chip, 2012, 12, 2998–3007
8. Y. Zhang , Y. Liu, Z. Wang, "Fundamental Theory of Piezotronics", 2011 Adv. Mat., pp. 1-10
9. Introduction to COMSOL Multiphysics, 1998-2012 COMSOL