MN-ENE9005	MEMS energy harvesting from motion	5 ECTS Credits

English		AUTUMN

INTRODUCTION

Vibration energy harvesting is to power sensors and electronics by mechanical-to-electrical conversion from vibrations in machinery, vehicles or the human body. The technology provides an alternative or supplement to the use of batteries and can potentially be used also under environmental conditions that batteries cannot survive. The research into MEMS vibration energy harvesting is about making miniaturized such generators as microfabricated chips. There are several challenges related to this with regard to fabrication technology, the fact that miniaturization is a disadvantage for generators relying on inertia and that vibration spectra can have a diverse character. This course give an in depth description of the fundamental workings to such devices and the current state of the art.

LEARNING OUTCOMES

KNOWLEDGE
Upon successful completion of this course you will be able to describe the working principles of vibration energy harvesters based on the three main transduction principles, outline the main challenges in the field and give examples from the research literature on how these challenges are met.

SKILLS
Upon successful completion of this course you will be able to detail model and simulate inertial generators of either transduction type. You will know how to estimate performance and perform feasibility analysis on power generation. You will able to distinguish how various operating conditions affects the requirements for the designs and construct a generator.

GENERAL COMPETENCE
In addition to specific knowledge of vibration energy harvesters you will obtain an in-depth insight into electromechanical transducers in general. You will have practice in writing a paper.

CONTENTS

Topics of study (curriculum):

- basics of energy harvesting from motion
- electrostatic, piezoelectric and electromagnetic conversion for vibration energy harvesting
- load cycles and power management electronics
- vibration signals: harmonic, impulses, random noise
- linear transducers
- mechanical end-stops
- gas damping
- nonlinear conversion techniques
- lumped equivalent-circuit modelling and simulation
- recent advances

LEARNING ACTIVITIES

The course is given as an intensive cours over 8 days:

- Lectures
- Homework assignments (voluntary)
- Project assignment with report written as a research paper

PREREQUISITE KNOWLEDGE

The student should have a master degree or equivalent that conforms to the admission criteria of the PhD programme. MN-MEM4200 or equivalent.

PARTICIPATION

- Attending lectures, discussions and presentations during the intensive course is mandatory
- Give a paper presentation
- Project assignment. A written report on the form of a scientific paper and solutions to a problem set must be submitted.

ASSESSMENT

During the subject

NA

Final assessment

Project assignment

Assessment grading

The subject is graded Pass/Fail.

Examination support materials

NA

READING LIST

Mandatory literature

Author	***Title***	***Publisher***	***Year***	***ISBN no***
Halvorsen	Lecture notes			
Halvorsen	All lectured material and handouts including an extensive list of research papers			

CONTACT PERSON

Professor Einar Halvorsen, e-mail: **Einar.Halvorsen@hive.no**, tel: 33037725

OTHER INFORMATION
