

# Piezoelectric Vibration Energy Harvesting Under Uncertain Environment – A Short Course

## Overview

The teaching is aimed at graduate (PhD, MSc) and final year undergraduate students (MEng) students. Vibration energy harvesting is an emerging topic and there are very few courses available for research students. Over the past ten years there has been an explosive growth in research activities and most works are available as journal / conference papers only. This course will bring together latest research by the applicants group in Swansea and works by other researchers in the field. The focus will be on energy harvesting under the condition when excitation forces are random in nature. Proposed eight lectures will cover: 1. Introduction to piezoelectric cantilevers, 2. Reduced-order model for energy harvesters, 3. Introduction to random vibration, 4. Energy harvesting due to random excitations, 5. Optimal parameter design for random excitations, 6. Extreme response-based design of energy harvesters, 7. Introduction to nonlinear energy harvesters, 8. Nonlinear energy harvesters with random excitations.

Dates for the course	<b><u>2 April 2018 – 4 April 2018</u></b>
Host Institute	<b>Rice University, Houston</b>

## Objectives

The proposed course aims to introduce the concepts of piezoelectric vibration energy harvesting using analytical, numerical and experimental approaches. Main objectives are:

1. To develop and explain linear and nonlinear coupled electro mechanical equations governing piezoelectric vibration energy harvesting
2. To explain solution methods of the governing equations with harmonic and random forcing
3. To develop parameter optimisation methods for maximising energy harvesting under different forcing
4. Numerical solutions of coupled mechanical and electrical equation in a multi-physics environment.
5. Introduction to dynamics of coupled nonlinear electromechanical systems subjected to random excitations.

## Who should Attend the Course?

Anyone interested in addressing future energy challenges by mechanical approaches should attend the course. The course is inherently multidisciplinary in nature and specifically strong background in any particular topic is not necessary. Therefore, attendees with the following backgrounds are encouraged:

- Engineering Senior Graduate and Post-graduate students with disciplines such as, mechanical, civil, electrical, aerospace, mechatronics, electronics.
- Science Senior Graduate and Post-graduate students with disciplines such as, physics, materials science and mathematics.
- Researchers interested in and/or working in the fields of energy, structural vibrations, dynamics, smart materials, structural health monitoring and uncertainty quantification.

## The Teaching Faculty



**Prof Adhikari (PhD, Cambridge)** is the Chair Professor of Aerospace Engineering at the College of Engineering of Swansea University. He Received the Wolfson Research Merit Award from the Royal Society (UK academy of sciences). He was an Engineering and Physical Science Research Council (EPSRC) Advanced Research Fellow and winner of the Philip Leverhulme Prize in Engineering (given to an outstanding scholar under the age of 35). He obtained his Ph.D. in Engineering at the Trinity College of the University of Cambridge. He was a lecturer at the Bristol University and a Junior Research Fellow in Fitzwilliam College, Cambridge. From 2015 he has been a Distinguished Visiting Professor at the University of Johannesburg (South Africa). He was a visiting Professor at the University of Paris East (France), Carleton University (Canada) and a visiting scientist at the Los Alamos National Laboratory (USA).

Professor Adhikari's research stands on three fundamental footings - structural dynamics, probabilistic methods and computational mechanics. His research works use these basic principles to understand cutting edge multiscale and multidisciplinary problems in applied science and engineering. He has published 4 books, 270 peer-reviewed journal papers, and 170 conference papers. He is one of the most cited researchers in his field (over 9000 citations with h-index=51). He has supervised over 15 Ph.D. students and postdocs. Professor Adhikari is a Fellow of Royal Aeronautical Society (FRAeS) and the member of the AIAA Non-Deterministic Approaches Technical Committee (NDA-TC). He is a member of the editorial board of several journals such as: Computers and Structures, Probabilistic Engineering Mechanics and Journal of Sound and Vibration.