	INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI **SHORT ABSTRACT OF THESIS**	
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Thesis Title: Nonlinear Dynamics of Piezoelectric based Energy Harvester under Parametric and Galloping Instabilities		
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SHORT ABSTRACT

The present study is attempted to utilize the geometric and inertial nonlinearities along with modal interactions for piezoelectric based energy harvesting by extracting energy from parametric and galloping instabilities. In this research work, four nonlinear problems related to piezoelectric energy harvester systems have been investigated. In all the cases, the harvester system consists of a vertical cantilever beam with piezoelectric patches and attached mass at an arbitrary position. In the first work, nonlinear dynamic analysis of a cantilever beam based piezoelectric energy harvester subjected to parametric base excitation is carried out. In the second problem, the harvester subjected to a combination parametric resonance case has been studied. In these problems, the second mode frequency is considered to be approximately three times the first mode frequency, giving rise to an internal resonance of 1:3. In the third problem, an experimental setup has been developed to validate the theoretically studied PEH systems with base excitation under parametric resonance conditions. In the fourth work, galloping based harvester is investigated both theoretically and experimentally. The governing equations of motion of the above-mentioned systems have been derived either by force-moment balance (Newton's method) or by energy balance approaches. These spatiotemporal governing equations of motion are then discretized to their temporal forms by using generalized Galerkin's method. The method of multiple scales is then applied to reduce the second order differential equations to a set of first order differential equations. These equations are then used to obtain the steady state response and stability either by using numerical methods for solving differential equations (Runge-Kutta method) or by solving a set of algebraic or transcendental equations by using Newton's method. Both time and frequency responses have been plotted to obtain the output voltage and power.

The developed analytical solutions are found to be in good agreement with the experimental findings. Hence, the developed analytical expressions for piezoelectric based energy harvesters with the principal or combination parametric resonance conditions or the galloping based PEH system can be used effectively for determination for design and development of new PEH systems without conducting expensive experiments in facilities such as wind tunnels. These PEH systems may be used in making smart, self-sufficient devices that will provide energy to low powered wireless sensor nodes or microelectromechanical systems for structural health monitoring, reconnaissance purposes, and many other applications.