**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**

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Thesis Title: **Nano-Enabled Electronic Devices for Sensing and Energy Harvesting**

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## SHORT ABSTRACT

The number of patients worldwide are increasing at an alarming rate and thus the burden on secondary and tertiary healthcare system are increasing day by day. In order to meet the demand for healthcare facilities, it is now extremely important to strengthen the primary health care system. In this direction development of point-of-care-testing (POCT) devices for on-site and early detection is extremely important. The research work of this thesis focuses on the development of affordable, rapid, user-friendly point-of-care testing sensors and devices harnessing the attributes of nanotechnology, electronic devices, wearable and flexible electronics, and microfluidics for healthcare applications. Multiple devices and sensors were developed for the early diagnosis of chronic obstructive pulmonary devices (COPD), neurological disorders, eye-related diseases, cancers among others. A section of the research work also addressed non-conventional microfluidic electrical energy harvester based on zeta potential. The research work also includes nanostructure based back-gated FET and spintronics based magnetoresistive device for sensing application. The research work also involves few simulations in atomistic toolkit, COMSOL and Matlab to understand the physics associated with the phenomenon. Moreover, several fabrication and characterization instruments such as FESEM, Mask Writer, Electron Beam Lithography (EBL), Thermal Evaporation Deposition System, Optical microscope, Raman spectroscopy, XRD, UV-Vis spectroscopy, FTIR, sourcemeter, digital multimeter digital oscilloscope, and other small electronic instruments were an integral part of this research work.

The thesis targets the development of different bio-medical devices for point-of-care testing applications. In order to develop such sensors, different pathways have been explored such as microfluidics, spintronic, and electronic. The idea is to develop the effective point-of-care testing device, which can be utilized to monitor the health parameters. It is necessary to develop POCT devices in order to increase the awareness about the diseases. At the same time, as discussed earlier, it is also necessary to decentralize the pathological activity, so that people can have easy access to the early diagnosis facilities.

With this background, the present thesis explores a host of pathways to develop proof-of-concept prototypes targeting biomedical applications, environmental monitoring, and renewable energy harvesting. The thesis is divided into three different sections, namely, (I) Microfluidic Sensors, (II) Paper-Based Electronic Sensors, and (III) Other Electronic Sensors and POC Devices. Each section contains two or more technical chapters. In total, the thesis contains eight different technical chapters such as, (i) self-spinning nanoparticle laden microdroplets for sensing and energy harvesting, (ii) droplet based detection of blood α-amylase employing thermal Marangoni effect, (iii) paper based flexible touchpad and hand tremor detection device, (iv) nano-enabled paper humidity sensor for mobile based point-of-care lung function monitoring, (v) paper based GMR nanobiosensor for *α*-amylase estimation under impulse magnetic field, (vi) a nano-BG-FET for point-of-care estimation of ammonia and urea in human urine, (vii) a prototype for point-of-care stress detection at different body parts, and (viii) conversion of observed speed of a moving object to diagnose tunnel vision. The technical chapters in the thesis are preceded by an introductory chapter while at the end of the thesis a chapter containing the summary and future scopes are included. A brief detail of outcomes of this thesis in terms of patents, publications, conferences, and awards has also been provided at the end of the thesis.