# ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

**Shobhavan Campus, Mijar, Moodbidri - 574225**

(Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi & Recognized by Government of Karnataka)

ALVA'S

Education Foundation®

A Report on

# "MEMS LAB"

## Department of Electronics and Communication Engineering

# Contents

# Micro Electro Mechanical Systems (MEMS) Laboratory

MEMS is a process technology used to create timing integrated devices or systems that combine mechanical and electrical components. They are fabricated using integrated circuits(IC) batch processing techniques and can range in size from a few micrometers to millimeters. MEMS technology exploits the existing microelectronics infrastructure to create complex machines on a micrometer scale. Extensive applications for these devices exist in both commercial and industrial systems. Well-known components such as integrated silicon pressure sensors, accelerometers, and motion detectors have found use for several years in automotive and industrial applications. It is common knowledge that MEMS are made of tiny electromechanical components, but some engineers do not appreciate the fact that almost all MEMS devices involve multiple areas of physics—multiphysics. At a minimum, MEMS devices involve at least the electrical and mechanical sciences. It is also common that the electronic and mechanic elements are coupled through thermal or electrochemical effects, thereby adding a third or fourth physical phenomenon to the system.

The multiphysics nature of MEMS devices requires that a system designer has a vast understanding and knowledge of these various branches of physics. Because some micro scale effects are totally new or behave differently than at the macro scale, engineers require new system-design philosophies. They likely find it difficult to split one design into parts, which is common for macro scale device, where one engineer can fully study the mechanics while others concentrate, for instance, on the electrical or thermal aspects. Thus the MEMS engineer is a true systems designer, handling several physical phenomena simultaneously—and COMSOL Multiphysics and the MEMS Module can do the same. Most MEMS devices are manufactured using lithography-based micro fabrication, a technology that the microelectronics industry has refined for highly integrated circuits. Thanks to these efforts there are excellent methodologies and facilities for mass production. Suppliers can thus set the price of microsystems at a totally different level compared to their macro scale counterparts.

**Vision of the Department**

Centre of Excellence to empower the young minds in the field of Electronics and Communication Engineering with research focus and skill development through Transformative Education catering to the needs of the Society.

**Mission of the Department**

- To create Learning Environment to enable the Students for Excellence in the field of Electronics and Communication Engineering.
- To Empower the Students with necessary Skills for Solving the Complex Technological Problems.
- To Inculcate Research Culture among Teaching-Learning Group by guiding them towards Research Activities to bridge the gap between Industry and Academia.
- By Imbibing the Students with Human Values and Ethics through Transformative Education and make them Socially Responsible Professionals.

**Objectives of the Department**

- To build an understanding of microscale physics to the students for use in designing MEMS applications or micromachined devices.
- To take strides in microsystems technology and various fabrication techniques which enables them to design, analysis, fabrication and test MEMS based models in CAD simulation tools.
- To create a common research platform, purposed in forming an interdisciplinary group working on a project of MEMS device which incorporate engineers of multiple domain.

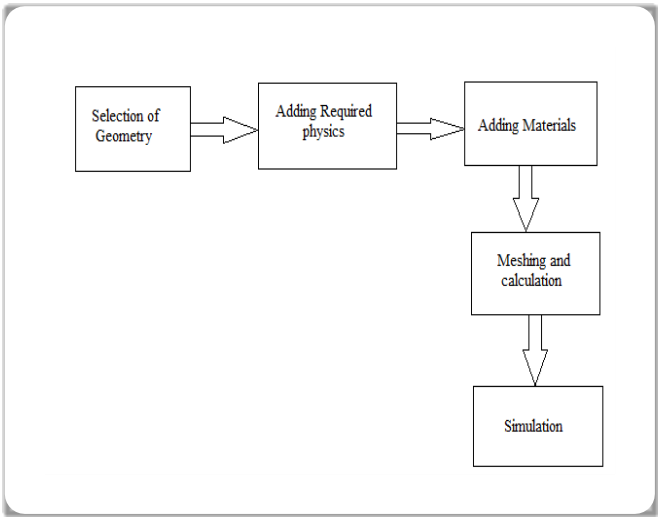


**Figure 1: Block diagram of MEMS Flow**

Lithographic fabrication techniques, however, do present some limitations on geometrical structures in MEMS devices. Micro fabrication is based on planar technology where the components are usually flat. From the modeling point of view, a flat structure presents some challenges, specifically in mesh generation and in finding numerical solutions. To get accurate solutions, the shape of a single triangle (2D) or tetrahedron (3D) in the mesh should be as regular as possible. In flat structures, regularity can be achieved by decreasing the mesh size to accommodate the shortest distances, but doing so increases memory requirements. Fortunately, advances in modeling techniques such as mesh rescaling, mesh mapping, and mesh extrusion can reduce the mesh size and relieve memory demands. In addition, certain industries have moved away from the use of silicon in favor of glasses and plastics, and chips in biotechnology, which include micro-fluidic systems that can be regarded as true MEMS devices, now emerge on the market.

MEMS pioneers in both research and industrial organizations have solved several challenges in the modeling and manufacturing areas. They have been able to apply existing tools to help analyze the behavior of MEMS devices through numerical methods. Meanwhile, it is apparent that the time is right to introduce new tools that demonstrate how well finite- element-based numerical solvers perform in this area. For modeling of micro-fluidics, the dedicated Micro-fluidics Module contains tailored physics interface for simulation of micro- fluidic devices, including creeping flow, thin-film flow, multiphase flow, and free molecular flow.

Micro electronics act as “brain” while sensors and actuators act as “eyes” and “arms” to allow the system to control and sense the environment.

## Advantages of MEMS

- Entire systems can be miniaturized.
- Reduced manufacturing cost due to mass production.
- High reliability, precision and functionality of systems.
- Large number of MEMS devices fit into a small area.
- Low power consumption.
- Portability.

# Report on MEMS LAB Inauguration

**Inauguration of MEMS LAB** was conducted on **26.11.2016** by the well know personalities **Padmavibhushana Dr. Vasudev K Aatre** (Former DG-DRDO & scientific advisor, Defence Ministry of India), **Dr. Prakash D Mangalgiri** (Group director ADA Bangalore), **Dr. M Mohan Alva** (Chairman, AEF), **Sri Vivek Alva** (Managing Trustee), **Dr. Peter Fernandes** (Principal), **Dr. D V Manjunatha** (HOD, E&CE Dept.) & **Dr. Praveen J** (Dean academics),


**MEMS Inauguration**


**MEMS Inauguration by Dr. M Mohan Alva and Dignitaries**


**MEMS Simulation Lab and Board Room**

**MEMS Simulation Lab**

**MEMS Lab Board Room**


**VTU Research Centre R&D LAB**

# Facilities available in MEMS laboratory

| | |
|---|---|
| Systems | : 20 numbers DELL |
| AC | : 4 numbers |
| RAM | : 16GB,32GB |
| HDD | : 1TB |
| Operating systems | : windows 10 pro |
| Application Software | : Comsol 5.2 / 5.0/ 4.3 & Coventorware |
| Processor | : Intel ® cote ™ i5-6500 CPU 3.2GHz |
| Board room | 1 |
| HOD room | 1 |
| Lab room | 1 |
| Reserved lab room | 2 |
| Battery section | 1 |

**Composition Details**

**AIET Moodbidri – MEMS Lab**

**Lab Incharge –Dr D V Manjunatha**
**Dr. Guruprasad**

# Technical Talk Report on Innovative Developments in MEMS Gas Sensors

**Inaugural Function:** The technical talk on "Innovative Developments in MEMS Gas Sensors" commenced on **27.9.2023 at 10:30 AM**. The prestigious event was inaugurated by Dr. Siddesh G K, Dr. D V Manjunatha, Dr. Veerpratap V, and Udayakumar. The event took place at department seminar hall, organized by the MEMS CLUB at AIET, Moodbidri.

**Keynote Speaker: Dr. Shwetha H R (JNNCE Shimoga):** Dr. Shwetha H R, a renowned expert in the field of MEMS (Micro-Electro-Mechanical Systems), graced the occasion as the resource person. Dr. Shwetha H R brought a wealth of knowledge and experience to the event, setting the stage for an insightful discourse on the latest innovations in MEMS gas sensors.

**Event Overview:** The technical talk delved into the cutting-edge advancements in MEMS gas sensors, a crucial component in various industries such as environmental monitoring, healthcare, and industrial safety. Dr. Shwetha H R provided a comprehensive overview of the current state of MEMS gas sensor technology and its implications for the future.

**Topics Covered:**

1. **Introduction to MEMS Gas Sensors:** Dr. Shwetha initiated the talk with a brief overview of MEMS technology and its applications, highlighting the importance of gas sensors in modern engineering.
2. **Evolution of Gas Sensor Technology:** The speaker provided insights into the historical development of gas sensor technology, emphasizing the pivotal role played by MEMS in pushing the boundaries of sensitivity, selectivity, and miniaturization.
3. **Innovative Sensor Designs:** Dr. Shwetha H R shared information on the latest sensor designs and architectures that have emerged in recent research. This included advancements in materials, sensor configurations, and integration techniques.
4. **Applications in Different Sectors:** The talk explored how MEMS gas sensors are being utilized in diverse industries, from environmental monitoring to medical diagnostics. Dr. Shwetha provided real-world examples and case studies to illustrate the practical applications of these sensors.

5. **Challenges and Future Directions:** The presentation concluded with a discussion on the challenges faced in MEMS gas sensor development and the potential future directions for research and innovation in this field.

**Audience Engagement:** The technical talk was well-received by the audience, consisting of students, faculty, and industry professionals. A Q&A session followed the presentation, allowing attendees to engage with Dr. Shwetha H R and seek clarifications on various aspects of MEMS gas sensors.

**Closing Remarks:** Dr. Siddesh G K, Dr. D V Manjunatha, and Dr. Veerpratap V expressed their gratitude to Dr. Shwetha H R for sharing her expertise and insights. They highlighted the significance of such events in fostering a collaborative and knowledge-sharing environment.

**Conclusion:** The technical talk on innovative developments in MEMS gas sensors organized by MEMS CLUB at AIET, Moodbidri, served as a platform for learning, discussion, and networking. The event contributed to the dissemination of knowledge and the promotion of advancements in MEMS technology, reaffirming the institution's commitment to staying at the forefront of technological developments.

Co-ordinator

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## Glimpses of the Technical Talk:

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Principal

## Participants List

| Student Name | Signature |
|---|---|
| ABHISHEK S | |
| Basavakiran | |
| Bharath N | |
| Chithra L | |
| GAGAN H S | |
| HuriyaSanadi | |
| Keerthan S | |
| Lekhan T | |
| Nagabhushan H K | |
| Prakruthi K P | |
| Ravi Kovi | |
| Sahana | |
| Saikumar | |
| Santhosha S | |
| Shreyas S Naik | |
| Shruthi | |
| Siddharoodh B Durgipujeri | |
| Sinchana R | |
| Sinchana RD | |
| Sindhu KS | |
| Sindhu S Patil | |
| Suma K G | |
| Sumith N | |
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