

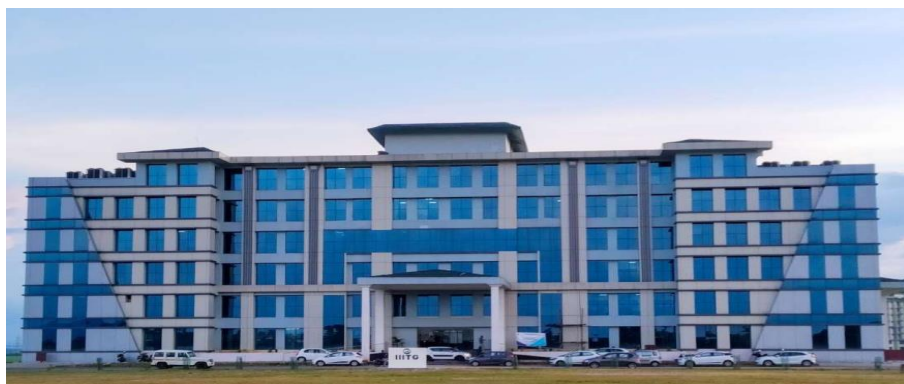


## SCIENCE AND ENGINEERING RESEARCH BOARD

वृतिका (Training and Skill Internship)

On

**The Development of the Memristors to Speed up  
Neuromorphic Computing**  
(30<sup>th</sup> May – 15<sup>th</sup> July, 2023)



**ORGANIZED BY**



Indian Institute of Information Technology Guwahati  
Bijoy Nagar – Jalukbari Road, Bongora, Guwahati, Assam, 781015,  
[www.iiitg.ac.in](http://www.iiitg.ac.in)

### COORDINATOR

Dr. Mourina Ghosh

### ADDRESS FOR CORRESPONDENCE

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**Proposed no of Participants:** 5 PG / PhD / UG 4<sup>th</sup> year Students

**How to Apply:** Participants interested to attend the internship program should register online in the below mentioned link

<https://forms.gle/4JZ26ceEEfEGfRsm7>

### Important Dates

Registration opens

May 17, 2023

Last date for application

May 25, 2023

**Shortlisted candidates are notified through mail**

Internship Dates

May 30 – July 15, 2023

\* The dates for the internship may vary depending on the release of funds from SERB.

### **ABOUT THE INSTITUTE:**

Indian Institute of Information Technology Guwahati (IIITG) is a premier Institute of North-Eastern part of India It has also been declared as Institute of National Importance by the Government of India. It has also been declared as Institute of National Importance by MoE, Govt. of India under the ambit of IIIT PPP Act 2017. It is foremost Institute providing superior quality higher education in the above areas and is located at Bongora in the city of Guwahati in the state of Assam, North-Eastern part of the country, commonly known as the land of red rivers and blue hills. The Institute activities are aimed at developing a culture of inquiry and research through highly competitive academic environment, and close interaction between Institute and corporate world. Vibrant links with the industry are active. In its very first year when it became eligible, IIITG has got a rank of 66 in the Engineering category of NIRF 2020. What is even more notable is that it is ranked the highest among all MHRD IIITs! This includes even the older, Govt. funded IIITs.

### **ABOUT ACCELERATE VIGYAN:**

"Accelerate Vigyan" (AV) strives to provide a big push to high-end scientific research and prepare scientific manpower which can venture into research careers and knowledge-based economy. Recognizing that all research has at its base as development of quality, well-trained researchers; AV will initiate and strengthen mechanisms of identifying research potential, mentoring, training and hands-on workshops, on a broad-based national scale. The aim is to expand the research base in the country, with three broad goals - consolidation/aggregation of all scientific training programs, initiating High end Orientation Workshops and creating opportunities for Training and Skill Internship.

### **OBJECTIVE:**

Neuromorphic computing is pursued to overcome the limitations of von Neumann architecture and Moore's law. Harnessing brain-inspired properties such as in-memory computing, spike-based encoding, and adaptation has demonstrably shown to bolster energy-delay efficiency by.

three order of magnitude classes of computation. The use of functional building blocks in integrated circuits that exhibit characteristics similar to the biological building blocks of the central nervous system is expected to enable circuits to mimic tasks associated with human cognition and sensory perception. Thus, a variety of approaches has been used to design electronic neurons that generate spiking signals and to implement synaptic interconnects. The memristor was introduced by Chua in 1971 as a circuit element that is as fundamental as R, L, and C. The notion of the memristor was generalized by Chua and Kang in 1976. The research and development of memristor circuits and systems were propelled by the nanoscale memristors fabricated by Williams et al. in 2008. Since then, a myriad of applications has been developed for memristors in storage-class memory, sensing, logic operations and memcomputing. Recently, memristors have become available through commercial fabrication processes and are commercially used in non-volatile resistive random-access memories (RRAM). An application of 4Mb RRAM array for record-breaking acceleration of machine learning was reported in the 2021 ISSCC. Memristor technologies have ushered in new approaches for emulating both biological neurons and synapses.

In this program, we will discuss and design memristors that helps for designing new building blocks for memristive neural networks for AI hardware acceleration. In this This program is intended to provide opportunity for young researchers to enrich their knowledge in the area of memristor desing for speed up neuromorphic computation such as:

1. Focus on Recent trends in memristor design for Neuromorphic Computation.
2. To provide a comprehensive overview of the fundamental concepts of MOS based memristor design.
3. Design and analysis of different parameters of the MOS-based Memristor.

### **INTERNSHIP CONTENTS:**

**Module 1. Evolution and requirement of Memristors for the Neuromorphic computation.**

**Module 2. Complete analysis and design procedure of grounded / floating, Incremental, and decremental memristor emulators using MOSFET.**

**Module 3. Design of a memristor emulator in Cadence Virtuoso and analysis of different parameters. Also perform some applications, such as neuromorphic networks, logic circuits etc.**

**Module 4. Layout, post layout and Hardware verification of the designed memristor circuit.**

**Students or the participants have to work on the live project given by the Faculty Co-ordinator or Event Organizer. This internship will be evaluated on the basis of the project assigned to them.**

### **INTERNSHIP OUTCOMES:**

- Participants will be able to understand the fundamental of Memristor design and Analysis.
- She/he will be able to compare and design its parameters with existing designs.
- Publications at conferences are also the benchmark.

### **WHO CAN APPLY?**

PhD, PG (M.Tech/M.E./M.S.) and UG 4<sup>th</sup> year level students in their endeavors for pursuing a scientific career.

### **HOW TO REACH:**

IIIT Guwahati is located in Bongora, Guwahati near Guwahati international airport. The institute is around 10 - 15 minutes (about 4 km) from the Guwahati airport and around an hour's drive from the Guwahati Railway Station. The institute is easily accessible by road, and there are cabs and auto-rickshaws to commute from railway station or airport. There is also an extensive network of city buses.

### OTHER IMPORTANT INFORMATION FOR PARTICIPANTS:

- The internship will be conducted in physical mode.
- Registration is free for all participants.
- **Seats are limited (only 5 participants)** and the participants will be selected based on merit.
- The internship will be on an unpaid basis. However, support for daily necessary expenses such as accommodation, food etc. including travelling allowance (TA) will be provided to the interns.
- The interns will be eligible for TA reimbursement for their journey to IIIT Guwahati from their hometown/home institute, both ways, as per GOI norms.
- After the registration closes, shortlisted candidates will be informed through email.
- Selected candidates will have to acknowledge participating in the internship through return email failing which the waitlisted candidates may be called for attending the workshop.

### SCHEDULE PLAN:

| DATE  | Internship Training Milestone   |
|---|---|
| <b>30<sup>th</sup> May to 10<sup>th</sup> June, 2023</b>  | <ul style="list-style-type: none"><li>▪ Fundamental of Memristor design and its requirements in Neuromorphic Computing.</li><li>▪ Assign individual project to the participants.</li></ul>  |
| <b>11<sup>th</sup> June to 22<sup>nd</sup> June, 2023</b> | <ul style="list-style-type: none"><li>▪ In-depth training in the design of a Memristor using MOSFET.</li><li>▪ Hands-on training on the various simulation tools such as Cadence Virtuoso.</li></ul>  |
| <b>23<sup>rd</sup> June to 3<sup>rd</sup> July, 2023</b>  | <ul style="list-style-type: none"><li>▪ Different parameter Analysis such as Monte Carlo, non-volatility etc.</li><li>▪ Layout and post-layout simulations of the Memristor in Cadence Virtuoso.</li><li>▪ Also perform some applications such as chaotic circuits, neuromorphic networks, logic circuits, etc. using memristors.</li></ul> |
| <b>4<sup>th</sup> July to 15<sup>th</sup> July, 2023</b>  | <ul style="list-style-type: none"><li>▪ Experimental or Hardware Verification of the design memristors.</li><li>▪ Evaluation of the projects allocated to the participants.</li></ul>   |

**Experts Details:**

Dr. Mourina Ghosh, Assistant Professor, IIIT Guwahati, Assam, India  
Further Queries Please write to: [mourina@iiitg.ac.in](mailto:mourina@iiitg.ac.in)

