

Indian Institute of Technology (IIT), Kanpur

Department of Electrical Engineering

New course

Title: Memory Technology and Neuromorphic Computing
Course No: EE 698P (PG level)
Credits: 3-0-0-9 [L-T-P-C]
Semester: II
Name of proposer: Dr. Shubham Sahay

Course contents: (assuming total of 40 lectures of 50 minutes)

S. No.	Topic	No. of lectures
1.	Memory organization and overview of memory technology: market, trends and technologies	2
2.	Volatile memory technology: Static Random-Access Memory (SRAM)	3
3.	Volatile memory technology: Dynamic RAM (DRAM), 1T-1C architecture, Capacitorless-DRAM	3
4.	Flash memory: NOR and NAND architecture, Poole Frenkel emission and Fowler-Nordheim tunneling, floating gate (FG) and charge-trap (CT) NAND flash, reliability, scaling and multi-bit capability (MLC)	5
5.	3D NAND Flash memory: BICS, TCAT, V-NAND, VG NAND Flash, reliability and MLC	4
6.	Embedded Flash memory technology: silicon and metal nanocrystals, engineered CT layers and split- gate memory architectures	3
7.	Emerging non-volatile memories (eNVM): Resistive RAM (RRAM), unipolar and bipolar stacks, oxygen vacancy and ionic transport, reliability, endurance, MLC	3
8.	eNVM: Phase change memory (PCM), Ovonic threshold switching, reliability, endurance and MLC	3
9.	eNVM: Ferroelectric RAM (FeRAM), Conductive Bridge RAM (CBRAM) and Spin-transfer Torque Magnetic RAM (STT-MRAM)	6
10.	Unconventional Application of eNVMS: Neuromorphic computing, Hardware security and Neuro-optimization	2
11.	Neuromorphic computing: Supervised learning with eNVMS	2
12.	Unsupervised learning with eNVMS	2
13.	Hardware accelerators	2

Recommended texts

- Y. Nishi and Magyari-Kope, "Advances in non-volatile memory and storage technology," Woodhead Publishing, 2019.
- R. Micheloni, "3D Flash memories," Springer Netherlands, 2016.
- Special issue of Proceedings of IEEE, IEEE Journal of exploratory solid-state devices and circuits, IEEE transactions on Electron devices on memory technology.