Robust Power Semiconductor IC Systems

March 4-8, 2018

Room 1003, Mayer Bld. Electrical Engineering Dept. Technion

The course conveys a solid understanding of the use of modern semiconductor technologies in power electronic applications. Based on the relevant figures of merit of Si, GaN and SiC based power semiconductors, aspects of power device characterization and modeling, circuit design, mounting and packaging and reliability will be covered. An additional focus is on the current front of research and development and the challenges of high power density and fast-switching power converter applications.

This course will be equally compelling for practitioners in industry who are looking for ways to reposition, further or deepen their careers toward cutting-edge power IC design.

Instructor: Prof. Ingmar Kallfass (see CV below).

Teaching assistant: Aleksey Dyskin

Prerequisite: Semiconductor Devices – 044125 (Integrated Power Devices 046235 is recommended but not necessary).

Lectures: 26 Hours
Course Syllabus and Schedule:

Day 1
9:00 – 12:00  **Power Semiconductor Devices in Power Electronics Applications**
   Application areas
   Recent Trends and Developments
13:00 – 16:00 **Power Semiconductor Figures of Merit**
   Baliga, Johnson FOM
   Switching Loss FOM and Intrinsic Semiconductor Limits
   Power Semiconductor Benchmarking
   Link budget calculations

Day 2
9:00 – 12:00  **Power Semiconductor Devices**
   Si MOSFET, IGBT
   SiC MOSFET, IGBT
   GaN HEMT, MISFET
13:00 – 16:00 **Static Device Characterization**
   IV, CV, gate charge
   Advanced concepts: on-state capacitance, S-parameter

Day 3
9:00 – 12:00  **Dynamic Device Characterisation**
   Double Pulse Test
   Nominal switching waveforms
   Parasitic inductance and ringing
   Current and voltage measurement
13:00 – 16:00 **Switching Loss**
   Turn-on loss
   Turn-off los
   Switch node capacitance
Day 4

9:00 – 12:00  **Thermal Analysis**

- Thermal material properties
- Thermal modeling
- Thermal FEM simulation

13:00 – 16:00  **Multi-Physics Simulation**

- Electro-magnetic and thermal coupled simulations
- Multi-domain optimization
- Thermo-mechanic coupling
- Accelerated lifetime tests
- Lifetime prediction

Day 5

9:00 – 12:00  **GaN Monolithic Integrated Power Circuits**

- Driver integration
- Quasi normally-off concept
- Temperature Sensors
- Free-wheeling diode
- Integrated half-bridge

13:00 – 16:00  **Fast Switching with GaN power transistors**

- Driver concepts
- Double pulse tests with up to 1000 V/ns slew rate

**Course Registration:**

To register please follow [this link](#). Please register with your corporate e-mail only. Please note that there are a limited number of places available on this course. Registration does not guarantee you a place in the class!

**Price:**

The course is free of charge to ACRC members (Intel, Marvell, Mellanox).
Non-ACRC members will be charged 3000 NIS + VAT.
Ingmar Kallfass received the Dipl.-Ing. degree in Electrical Engineering from University of Stuttgart in 2000, and the Dr.-Ing. degree from University of Ulm in 2005. In 2001, he worked as a visiting researcher at the National University of Ireland, Dublin. In 2002, he joined the department of Electron Devices and Circuits of University of Ulm as a teaching and research assistant. In 2005, he joined the Fraunhofer Institute for Applied Solid-State Physics with a focus on nonlinear millimeter-wave integrated circuit design. From 2009 to 2012, he was a professor at the Karlsruhe Institute of Technology in the field of high-speed integrated circuits in a shared professorship with the Fraunhofer IAF in the frame of the German Excellence Initiative. Since 2013, he holds the chair for Robust Power Semiconductor Systems at the University of Stuttgart as part of the Robert Bosch Center for Power Electronics, where his major fields of research are compound semiconductor-based circuits and systems for microwave and power electronics.