



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FAKULTAS TEKNOLOGI ELEKTRO DAN INFORMATIKA CERDAS
DEPARTEMEN TEKNIK ELEKTRO
Program Studi Sarjana (S1) Teknik Elektro

INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF INTELLIGENT ELECTRICAL & INFORMATICS TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING
Bachelor Degree Program in Electrical Engineering

1	Nama Mata Kuliah : Divais Semikonduktor dan Rangkaian Terintegrasi / / Course Name <i>Semiconductor Devices and Integrated Circuits</i>
2	Kode Mata Kuliah : EE234651 / Course Code
3	Kredit / Credits : 4 SKS
4	Semester / : 6 Semester

Deskripsi Mata Kuliah / Course Description

Mata kuliah ini membahas tentang teori bahan semikonduktor, prinsip kerja berbagai kelompok divais semikonduktor, piranti semikonduktor nanoelektronik, fabrikasi divais semikonduktor, serta perancangan rangkaian terintegrasi analog, digital, dan mixed-signal dengan teknologi mikroelektronika CMOS (complementary metal-oxide semiconductor). Bagian pertama mata kuliah ini memperkenalkan teori dan prinsip kerja berbagai divais semikonduktor untuk berbagai jenis aplikasi, serta proses fabrikasinya. Bagian kedua mata kuliah ini menekankan pada aspek perancangan rangkaian terintegrasi atau integrated circuit (IC), meliputi tahap rancangan skematik, simulasi, hingga layout untuk IC menggunakan CAD (computer aided design) tools untuk perancangan IC serta Process Design Kit untuk teknologi CMOS. / *This course covers the theory of semiconductor materials, the working principles of various semiconductor devices, nanoelectronic semiconductor devices, semiconductor device fabrication, and the design of integrated circuits (ICs) using analog, digital, and mixed-signal microelectronics CMOS (complementary metal-oxide semiconductor) technology. The first part of this course introduces the theory and working principles of various semiconductor devices for different applications, as well as their fabrication processes. The second part of the course emphasizes the design of integrated circuits (ICs), covering schematic design, simulation, and layout for ICs using computer-aided design (CAD) tools for IC design and a Process Design Kit for CMOS technology.*

Capaian Pembelajaran Lulusan (CPL) Yang Dibebankan Mata Kuliah / Program Learning Outcomes Charged to The Course

- CPL 3 Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan serta memahami kewirausahaan berbasis teknologi / *Able to manage one's own learning and continually self-develop as a lifelong learner to compete at the national and international levels, with the goal of making a tangible contribution to problem-solving by implementing information and communication technology and considering sustainability principles, as well as understanding technology-based entrepreneurship.*
- CPL 5 Mampu mendesain komponen, sistem, dan proses yang logis dan realistis sesuai dengan spesifikasi yang ditentukan dengan mempertimbangkan aspek keselamatan, sosial, budaya, lingkungan, dan ekonomi / *Able to design components, systems, and processes that are logical and realistic in accordance with specified specifications, while considering safety, social, cultural, environmental, and economic aspects.*
- CPL 7 Mampu mengetahui dan mengaplikasi metode, keahlian sesuai perkembangan terkini di bidang ilmu pengetahuan dan teknologi untuk menyelesaikan permasalahan teknik elektro dengan mengedepankan nilai-nilai universal / *Able to understanding and applying the latest methods and skills in the field of science and technology to solve electrical engineering problems while emphasizing universal values.*

Capaian Pembelajaran Mata Kuliah / Course Learning Outcomes

1. Mampu menjelaskan teori bahan semikonduktor, berbagai kelompok divais semikonduktor beserta prinsip kerjanya. / *Capable of explaining semiconductor material theory, various semiconductor device groups, and their operating principles.*
2. Mampu menjelaskan konsep rangkaian terintegrasi, perkembangan teknologi IC, dan proses fabrikasi divais semikonduktor. / *Able to explain the concept of integrated circuits, the development of IC technology, and the semiconductor device fabrication process.*
3. Mampu menerapkan alur pengembangan rancangan rangkaian terintegrasi CMOS menggunakan EDA tools dan technology file untuk perancangan skematik, simulasi, layout, dan verifikasi rangkaian terintegrasi. / *Proficient in applying the development flow for CMOS integrated circuit design using Electronic Design Automation (EDA) tools and technology files for schematic design, simulation, layout, and verification of integrated circuits.*
4. Mampu melakukan perancangan, simulasi, layout, dan verifikasi rangkaian terintegrasi CMOS digital, analog, dan mixed signal. / *Able to design, simulate, layout, and verify digital, analog, and mixed-signal CMOS integrated circuits.*

Pokok Bahasan / Contents

1. Teori atom, teori bahan semikonduktor, pita energi, semikonduktor ekstrinsik / *Atomic Theory, Semiconductor Material Theory, Energy Bands, Extrinsic Semiconductors*

2. Sambungan PN, junction diode, bipolar junction transistor / *PN Junction, Junction Diode, Bipolar Junction Transistor*
3. Transistor efek medan, MOSFET, FinFET, CMOS / *Field-Effect Transistor, MOSFET, FinFET, CMOS*
4. Piranti optoelektronik, piranti frekuensi tinggi, piranti dengan efek kuantum, piranti daya tinggi, dan piranti nanoelektronika / *Optoelectronic Devices, High-Frequency Devices, Quantum Effects Devices, High-Power Devices, and Nanoelectronic Devices*
5. Teknologi rangkaian terintegrasi, konsep technology scaling, proses fabrikasi IC CMOS / *Integrated Circuit Technology, Technology Scaling Concept, CMOS IC Fabrication Process*
6. Prinsip layout IC CMOS, dan alur desain IC / *IC CMOS Layout Principles and IC Design Flow*
7. Penggunaan Electronic Design Automation (EDA) tools dan Process Design Kit (PDK) teknologi CMOS untuk perancangan skematik, simulasi, layout, dan verifikasi rangkaian terintegrasi / *Utilization of Electronic Design Automation (EDA) Tools and CMOS Process Design Kit (PDK) for Schematic Design, Simulation, Layout, and Integrated Circuit Verification*
8. Perancangan rangkaian terintegrasi CMOS digital logika statis, standard-cell layout / *Design of Static CMOS Digital Logic Integrated Circuits, Standard-Cell Layout*
9. Perancangan rangkaian terintegrasi CMOS analog, teknik layout / *Design of Analog CMOS Integrated Circuits, Layout Techniques*
10. Rancangan rangkaian terintegrasi mixed-signal sederhana dengan teknologi CMOS / *Design of Simple Mixed-Signal Integrated Circuits using CMOS Technology*

Prasyarat / Pre-requisite

Pustaka / Reference

1. Sze Simon Min and Ming-kwei Lee. 2013. *Semiconductor Devices : Physics and Technology : International Student Version*. 3rd ed. New York: J. Wiley & Sons.
2. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 2nd edition, IEEE Press, Wiley-Interscience, 2005, USA.
3. SkyWater Technology Foundry, "Skywater Open Source PDK", <https://github.com/google/skywater-pdk>
4. Pierret Robert F. 2006. *Semiconductor Device Fundamentals*. Massachusetts: Addison-Wesley Longman.
5. Streetman Ben G and Sanjay Banerjee. 2016. *Solid State Electronic Devices* 7Th edition Global ed. Boston: Pearson.