

Alanya Alaaddin Keykubat University | Rafet Kayış Faculty of Engineering
Electrical-Electronics Engineering Department
 2023-2024 Spring Semester

Syllabus

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| Code/Name | EEE 204 / Semiconductor Devices and Modelling |
| Type | Required |
| Credit/ECTS | 5/5 |
| Hour per Week | 3(3+0+0) |
| Level/Year | Undergraduate/2 |
| Semester | Spring |
| Classroom | A103 |
| Content | Basic semiconductor concepts. Physical electronics. Physics of p-n junction diodes, bipolar junction transistors (BJTs) and field-effect transistors. Transistor biasing and small-signal models. Secondary effects in transistors. Dynamic models for diodes and transistors. p-n-p-n switching devices. Modeling concepts for computer-aided design and introduction to circuit analysis with computer software.. |
| Prerequisites | None |
| Textbooks | <i>Primary</i> A. S. Sedra & A. Grabel, Microelectronic Circuits & Devices, Oxford University Press, 7th Edition, 2014 <i>Supplementary</i> B. G. Streetman and S. Banerjee, Solid State Electronic Devices, Prentice Hall Series. |
| Objectives | <ul style="list-style-type: none"> • To comprehend the fundamentals of solid-state electronics and semiconductor devices in order to utilize the semiconductor electron devices efficiently in discrete and integrated circuit applications • To understand, develop and use equivalent circuit models for semiconductor devices and perform analysis of transistor amplifier circuits. |
| Course Outcomes | In this course you will be able to: CO1 Understand the basic properties of semiconductors CO2 Utilize widely used equivalent circuit models for semiconductor electron devices to predict device behavior in electronic circuits CO3 Perform small signal analysis of amplifier circuits CO4 Perform computer analysis of circuits containing semiconductor devices CO5 Understand and use the newly developed devices in the future |

Weekly Schedule of Topics

| W | Topic |
|---|---|
| 1 | Course introduction, solid-state electronic materials, bonding forces and energy bands in solids |
| 2 | Impurities in semiconductors, drift and diffusion in semiconductors |
| 3 | Generation-recombination of electrons and holes, continuity and diffusion equations. |
| 4 | p-n junction under equilibrium and forward and reverse bias, derivation of diode current expression |
| 5 | Diode I-V characteristics, p-n junction capacitance, breakdown mechanisms, dynamic switching behavior of diode, photodetectors, solar cells, LEDs |
| 6 | Introduction to the Bipolar Junction Transistor (BJT) |
| 7 | BJT I-V characteristics and Ebers-Moll mode. |
| 8 | BJT capacitances, Early Effect in BJT and BJT biasing |
| 9 | MOS capacitor and introduction to MOSFET. |

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| 10 | MOSFET types and I-V characteristics, Body effect and channel length modulation |
| 11 | MOSFET biasing |
| 12 | MOSFET as a switching device |
| 13 | Small signal models for diodes and BJTS, transistor as an amplifier |
| 14 | The common emitter amplifier, small signal model for FETs, the common source amplifier |

Contribution to Program Outcomes*

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | 5 | 5 | 1 | 5 | 0 | 5 | 1 | 3 | 1 | 3 | 0 |
| CO2 | 5 | 5 | 1 | 4 | 0 | 5 | 4 | 3 | 4 | 3 | 0 |
| CO3 | 5 | 5 | 3 | 5 | 2 | 5 | 1 | 3 | 1 | 3 | 0 |
| CO4 | 5 | 4 | 3 | 5 | 0 | 5 | 2 | 3 | 1 | 4 | 0 |
| CO5 | 5 | 4 | 1 | 4 | 0 | 5 | 4 | 3 | 4 | 1 | 2 |

* Contribution Level | 0: None | 1: Very Low | 2: Low | 3: Medium | 4: High | 5: Very High

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| Requirements | Basic knowledge of Electromagnetic Field Theory |
| Course Policy | <ul style="list-style-type: none">• Be in the class on time.• English should always be used to communicate with one another.• At least 70% attendance is required, otherwise a grade of DZ will be assigned. |
| Cheating & Plagiarism | <ul style="list-style-type: none">• Copying or letting someone copy your work on exams, assignments, or reports is cheating.• Cutting and pasting text, figures and tables from web sources or any other electronic source is plagiarism.• The consequence of academic dishonesty is to receive a grade of FF for the course. |
| Evaluation | Midterm 40% <u>Final Exam</u> 60% Total 100% |

Instructor

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|--------------|---------------------|--------------|-------------------------------|
| Name/Surname | Fikri Serdar Gökhan | Email | serdar.gokhan@alanya.edu.tr |
| Room | 209 | Office Hours | W 11.30-12.30 F 13.30-14.30 |

Prepared by Akm Uslu on June 10th, 2024.