*Recommended template: “Course Description, Syllabus, Course Requirements”*

# course syllabus and course requirements academic year 2022/2023 semester 2

|  |  |
| --- | --- |
| Course title | Microelectronics |
| **Course Code** | **IVB273ANVM** |
| **Hours/Week: le/pr/lab** | **2 / 0 / 0** |
| **Credits** | **3** |
| **Degree Programme** | **BSc** |
| **Study Mode** |  |
| **Requirements** | **mid-term** |
| **Teaching Period** | **Spring** |
| **Prerequisites** | **none** |
| **Department(s)**  **Course Director** | **Department of Electrical Networks**  **Kisander Zsolt** |
| **Teaching Staff** | **Dr. Molnár László Milán assistant professor** |
|  |  |

# course description

*A short description of the course (max. 10 sentences).*

*Neptun: Instruction/Subjects/Subject Details/Basic data/Subject description*

The course is designed to connect the already known materials science knowledge of semiconductors to device-level working principles and their application in very-high scale integrated circuits and amplifiers.

# syllabus

*Neptun: Instruction/Subjects/Subject Details/Syllabus*

## **goals and objectives**

*Goals, student learning outcome.*

*Neptun: Instruction/Subjects/Subject Details/Syllabus/Goal of Instruction*

Electronic materials, especially focusing on semiconductors (intrinsic: Si, Ge; compound: III-V semiconductors). Transport processes in semiconductors – simplified quantum mechanics model, density of states; electron and hole transport. Working principle of p-n junction derived from transport processes. Characteristics of diodes, calculation methods (including approximation models). Field-effect transistors – working principle, types, structure; FET characteristics (parameters of FETs) and basic calculations of FET-based circuits (esp. common source). Realization of an inverter with FET. Bipolar transistors, characteristics, working modes. Early-effect, and other non-ideal effects. Common-emitter setup, load line, voltage transfer characteristics. Inverters, amplifiers and logical gates. Scaling problems of integrated circuits, manufacturing of devices. Introduction to optoelectronics; light-emitting devices.

## **course content**

*Neptun: Instruction/Subjects/Subject Details/Syllabus/Subject content*

|  |  |
| --- | --- |
|  | TOPICS |
| LECTURE | *1.- 2.: semiconductor physics considerations*  *3.-6.: basic devices: diodes, transistors*  *7.-10.: circuits and their manufacturing* |

### **DETAILED SYLLABUS AND COURSE SCHEDULE**

### *academic holidays included*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LECTURE | | | | |
| week | **Topic** | **Compulsory reading; page number**  **(from … to …)** | **Required tasks (assignments, tests, etc.)** | **Completion date, due date** |
| 1. | Introduction of microelectronics. | [1.] Sze Section 1.3. – 1.4. |  | 2023.02.06. |
| 2. | Electrical conduction in solids, semiconductors, p-n junction | [1.] Sze Section 1.3. – 1.4.  [2.] Neamen Section 1.1.1.-1.1.2  [2.] Neamen Section 1.1.3. |  | 2023.02.13. |
| 3. | P-n junction, diodes | [3.] Majumder et al. Section 1.2.  [2.] Neamen Section 1.2.-1.5 |  | 2023.02.20. |
| 4. | FETs | [2.] Neamen Chapter 3 |  | 2023.02.27. |
| 5. | MOSFETs | [2.] Neamen Chapter 3 |  | 2023.03.06. |
| 6. | Bipolar transistors, basic circuits | [2.] Neamen Chapter 5 |  | 2023.03.13. |
| 7. | **Mid-term test** |  |  | 2023.03.20. |
| 8. | Analog circuits | [2.] Neamen Part 2; Chapter 9, 12, 13 |  | 2023.03.27. |
| 9. | Spring holiday (no lecture) | | | 2023.04.03. |
| 10. | Easter (public holiday) | | | 2023.04.10. |
| 11. | VLSI scaling | [3.] Majumder Chapter 7 |  | 2023.04.17. |
| 12. | VLSI manufacturing |  |  | 2023.04.24. |
| 13. | Labour’s Day (public holiday) | | | 2023.05.01. |
| 14. | **Mid-term test** |  |  | 2023.05.08. |
| 15. | Supplementary mid-term |  |  | 2023.05.15. |

## **assessment and evaluation**

*(Neptun: Instruction/Subjects/Subject Details/Syllabus/Examination and Evaluation System)*

##### **Attendance**

*In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.*

***Method for monitoring attendance*** *(e.g.: attendance sheet / online test/ register, etc.)*

None

##### **assessment**

*Cells of the appropriate type of requirement is to be filled out (course-units resulting in mid-term grade or examination). Cells of the other type can be deleted.*

Course resulting in mid-term grade (PTE TVSz 40§(3))

**Mid-term assessments, performance evaluation and their ratio in the final grade** (The samples in the table to be deleted.)

|  |  |  |
| --- | --- | --- |
| **Type** | **Assessment** | **Ratio in the final grade** |
| *Mid-term test 1* | *max. 60 points* | *60%* |
| *Mid-term test 2* | *max 40 points* | *40%* |

**Opportunity and procedure for re-takes** (PTE TVSz 47§(4))

*The specific regulations for improving grades and resitting tests must be read and applied according to the general Code of Studies and Examinations. E.g.: all tests and assessment tasks can be repeated/improved at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.*

All tests can be repeated during the last lecture in the semester. In case of re-take, result of first try will be neglected in final grade.

**Grade calculation as a percentage**

based on the aggregate performance according to the following table

|  |  |
| --- | --- |
| **Course grade** | **Performance in %** |
| excellent (5) | 85 % … |
| good (4) | 70 % ... 85 % |
| satisfactory (3) | 55 % ... 70 % |
| pass (2) | 40 % ... 55 % |
| fail (1) | below 40 % |

The lower limit given at each grade belongs to that grade.

## **Specified literature**

*In order of relevance. (In Neptun ES: Instruction/Subject/Subject details/Syllabus/Literature)*

##### **compulsory reading and availability**

[1.] S.M: Sze, M.K. Lee: Semiconductor Devices – Physics and Technology ISBN 978-0470-53794-7

[2.] Donald A. Neamen: Microelectronics: Circuit Analysis and Design ISBN 978–0–07–338064–3

[3.] M.K. Majumder et al: Introduction to Microelectronics to Nanoelectronics – Design and Technology ISBN: 9781003049203 (ebk)