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|  | **ECTS Course Description Form** |
| **PART I ( Senate Approval)** |
| **Offering School**  | **Engineering** |
| **Offering Department** | **Electrical and Electronics Engineering** |
| **Program(s) Offered to** | **Electrical and Electronics Engineering** | **Compulsory** |
| **Computer Engineering** | **Elective** |
| **Industrial Engineering** | **Elective** |
| **Course Code**  | **EE 301** |
| **Course Name** | **Semiconductor devices** |
| **Language of Instruction** | **English** |
| **Type of Course** | Lecture (Theory) |
| **Level of Course** | **Undergraduate** |
| **Hours per Week** | **Lecture: 4** | **Laboratory:**  | **Recitation:**  | **Practical:**  | **Studio:** | **Other:** |
| **ECTS Credit** | **7** |
| **Grading Mode** | **Letter Grade** |
| **Pre-requisites** | *The successful completion of EE 212 Electromangetic Wave Theory and EE 242 Modern Physics for Engineers courses is prerequisite for taking EE 301 Semi-Conductor Device Principles* |
| **Co-requisites** | **-** |
| **Registration Restriction** | *-* |
| **Educational Objective** | The course aims to introduce basic semiconductor devices and their analysis. The student is expected to learn and apply the underlying physical principles behind electronic devices such as MOSFETs, BJTs, diodes etc. |
| **Course description** | The course covers the working principles of semiconductor devices such as p-n junction diodes, BJTs, and MOSFETs. To that end, an understanding of solid state physics is developed focused on semiconductors, which includes the concepts of crystal structure types, energy band structure, semiconductor doping, p-type and n-type materials, carrier dynamics etc. |
| **Learning Outcomes** | **LO1** | Be familiar with the terms, vocabulary and units of solid state physics and semiconductors |
| **LO2** | Understand the concepts, the relationships among concepts, and the laws and principles used in semiconductor physics*.* |
| **LO3** | Apply the concepts and the relationships to qualitative and quantitative problems |
| **LO4** | Analyze the working principle of semiconductor devices |
| **LO5** | Work cooperatively as part of a group on problem solving |
| **LO6** | Apply the basic principles involved in modern engineering and technology |
| **PART II ( Faculty Board Approval)** |
| **Basic Outcomes (University-wide)** | **No.** | **Program Outcomes** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
| **PO1** | **Ability** to communicate effectively and write and present a report in Turkish and English.  | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO2** | **Ability** to work individually, and in intra-disciplinary and multi-disciplinary teams. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO3** | **Recognition** of the need for life-long learning and **ability** to access information , follow developments in science and technology, and continually reinvent oneself. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO4** | **Knowledge** of project management, risk management, innovation and change management, entrepreneurship, and sustainable development. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO5** | **Awareness** of sectors and **ability** to prepare a business plan. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO6** | **Understanding** of professional and ethical responsibility and **demonstrating** ethical behavior. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **Faculty Specific Outcomes** | **PO7** | **Ability to develop, select and use modern techniques and tools necessary for engineering applications and ability to use information technologies effectively.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO8** | **Recognition of the effects of engineering applications on health, environment and safety in the universal and societal dimensions and the problems of the time and awareness of the legal consequences of engineering solutions.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO9** | **Ability to identify, define, formulate and solve complex engineering problems; and electing and applying appropriate analysis and modelling methods for this purpose.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **Discipline Specific Outcomes (program)** | **PO10** | **Gains comprehensive knowledge in mathematics, natural sciences, related engineering fields and general engineering subjects.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO11** | **Able to identify complex engineering problems and solve them with appropriate methods of analysis.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO12** | **Able to design a complex electronic system that meets the desired performance by using modern design techniques and taking real life conditions into account.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO13** | **Able to develop new techniques and tools for solution of current engineering problems.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO14** | **Able to use computer software and hardware technologies together with information technologies in an effective way.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO15** | **Able to produce innovative solutions for solution of current engineering problems by gathering data through experiment design and interpretation of results.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO16** | **Able to actively work individually or in teams where engineers from the same or different disciplines are involved.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO17** | **Gains competency in effective written and verbal communication, presentation and preparation of technical reports in Turkish and English.**  | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO18** | **Constantly increases knowledge with the awareness of lifelong learning by closely following the developments in science and technology .** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO19** | **Acts in accordance with scientific and ethical principles and the standards used in engineering practice at every stage of career** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO20** | **Able to describe concepts related to business life such as project management, risk management, change management, entrepreneurship and sustainability.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO21** | **Gains awareness of the legal consequences of engineering solutions developed together with the effect of engineering applications on health, environment and safety on a universal and social scale.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO22** | **Able to solve problems involving probability and statistics, derivative and integral calculations, multivariable mathematics, linear algebra, differential equations, and complex variables, and their electrical and electronics applications.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO23** | **Able to organize projects and events for the social environment they live in with the awareness of social responsibility and implement them.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO24** | **Able to plan and direct activities for employees under their responsibility to develop within the framework of a project.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
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| **PART III ( Department Board Approval)** |
| **Course Subjects, Contribution of Course Subjects to Learning Outcomes, and Methods for Assessing Learning of Course Subjects** | **Subjects** | **Week** |  | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
| **S1** | 1 | Basic concepts of semiconductors and semiconductor devices | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S2** | *2* | Band structure of solids | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S3** | *3* | Metals, insulators and semiconductors | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S4** | 4 | Electrons and holes in semiconductors | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S5** | 5 | Carrier concentration, Fermi level, and density of states | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S6** | 6 | Doping of semiconductors | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S7** | 7 | Carrier transport phenomena | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S8** | 8 | P-N junctions | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S9** | 9 | Diodes | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S10** | 10 | Bipolar Junction Transistors (BJTs) | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S11** | 11 | Field effect transistors | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S12** | 12 | MOSFETs | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S13** | 13 | Interaction of light with semiconductors | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **S14** | 14 | Solar cells | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* | *A1-A2* |
| **Assessment Methods, Weight in Course Grade, Implementation and Make-Up Rules**  | **No.** | **Type** | **Weight** | **Implementation Rule** | **Make-Up Rule** |
| **A1** | **Exams** | 80% | No electronic devices allowed in the exams except calculators  | The student is informed about a make-up exam in case his/her excuse is valid and an accompanying doctors report is provided. |
| **A2** | **Quiz** |  |  |  |
| **A3** | **Homework** | 10% | Homework questions are expected to be answered within 1 week. | The student is informed about a make-up homework in case his/her excuse is valid and an accompanying doctors report is provided. |
| **A4** | **Project** |  |  |  |
| **A5** | **Report** |  | - | - |
| **A6** | **Presentation** |  | - | - |
| **A7** | **Attendance/ Interaction** |  | - | - |
| **A8** | **Class/Lab./****Field Work** |  |  |  |
| **A9** | **Other** |  |  |  |
| **TOTAL** | **100%** |
| **Evidence of Achievement of Learning Outcomes** | At least one question from each subject is asked during the exams. A weighted average is calculated for each student based on the percentage of each assessment method. Students are required to obtain a minimum score out of 100 (determined by the instructor) to pass the course. This score is determined based on the class average. |
| **Method for Determining Letter Grade** | The scores of 2 exams, and 2 quizzes are used to calculate the final score. Maximum scores from each contributor is shown below.

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| --- | --- | --- | --- | --- |
| Assessment | Midterm | Final  | Homework | Total |
| Point | 40% | 50% | 10% | 100% |

The table below is used to convert the total point out of 100 to a letter grade:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Point | 100-75 | 74-70  | 69-65 | 64-60 | 59-55 | 54-50 | 49-45 | 44-40 | 39-35 | 34-30 |
| Grade | A | A- | B+ | B | B- | C+ | C | C- | D+ | D |

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| **Teaching Methods, Student Work Load** | **No** | **Method** | **Explanation** | **Hours** |
| ***Time applied by instructor*** |
| **1** | **Lecture** | Class content is explained by writing on the board and with computer presentations | 4x14 |
| **2** | **Interactive Lecture** |  |  |
| **3** | **Recitation** | Example questions are solved on the board | 2x14 |
| **4** | **Laboratory** |  |  |
| **5** | **Practical** |  |  |
| **6** | **Field Work** |  |  |
| ***Time expected to be allocated by student*** |
| **7** | **Project** |  |  |
| **8** | **Homework** | Homework is completed in preparation for quizzes | 4x4 |
| **9** | **Pre-class Learning of Course Material**  | Next class’ material is read before the class | 3x14 |
| **10** | **Review of Course Material** | Previous class material is reviewed each week | 3x14 |
| **11** | **Studio** |  |  |
| **12** | **Office Hour** | One-to-one meetings for discussions | 2x14 |
| **TOTAL** | *212* |
| **IV. PART** |
| **Instructor** | **Name** | Prof. Dr. Engin ARSLAN |
| **E-mail** | engin.arslan@antalya.edu.tr |
| **Phone Number** |  |
| **Office Number** | A1-21 |
| **Office Hours** | Determined during each semester, 2 hours per week |
| **Course Materials** | **Mandatory** | Physics of Semiconductor Devices, First Edition by J. P. Colinge and C. A. Colinge Semiconductor Physics and Devices, Fourth Edition by Donald A. Neamen |
| **Recommended** |  |
| **Other** | **Scholastic Honesty** | Violations of scholastic honesty include, but are not limited to cheating, plagiarizing, fabricating information or citations, facilitating acts of dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Any for of scholastic dishonesty is a serious academic violation and will result in a disciplinary action. |
| **Students with disabilities** | Reasonable accommodations will be made for students with verifiable disabilities. |
| **Safety Issues**  | The course does not require any special safety precautions. |
| **Flexibility** | Circumstances may arise during the course that prevents the instructor from fulfilling each and every component of this syllabus; therefore, the syllabus is subject to change.  Students will be notified prior to any changes.  |