**Global Learning Initiatives Program Course Syllabus**

Please complete the following form in English. The information will be updated to the Global Learning Initiatives Program website for students’ reference. If you will be offering more than one course, please fill out one form per course offered. Examples in grey.

**Course Information**

|  |  |
| --- | --- |
| Course Name  \*provide the **English** course name of the course. | Introduction to solid state physics |
| Lecturer(s)  \*provide the lecturers’ **English** name. If there are more than one lecturer, please indicate all lecturers in the column. | Sheng-Shiuan Yeh |
| Course Description  \*briefly describe the contents covered in the courses. | Most materials applied in industry are in their solid state. Paramount among these are semiconductors which are the basis of the entire electronics [1]. Thus, the study of solid state physics is important not only for students who will go to the semiconductor industry, but also for further advanced research. The objective of this course is to introduce the basic knowledge in solid state physics with focusing on the key physical concepts. We will start with a brief review of the quantum mechanics and apply these principles to develop the basic concepts of solid state physics, including phonons and electronic energy band theory. Then, in terms of these knowledge, we will discuss charge transport properties in metals and semiconductors. Finally, we will introduce the concepts of insulators, dielectrics, and magnetism.  [1] S. H. Simon, The Oxford Solid State Basics (Oxford University Press, 2013). |
| Course Objectives  \*list out knowledge or skills students should acquire upon completion of course. | 1. To introduce the basic knowledge in solid state physics with focusing on the key physical concepts. 2. Students will learn the brief concepts of solid state physics, including phonons, electronic energy band theory, charge transport properties in metals and semiconductors, insulators, dielectrics, and magnetism. |
| Suggested Proficiencies  (if any)  \*list preferred knowledge or skills students should have before taking the course. |  |
| Reading List  (if any)  \*list out the textbooks, references, or other reading materials. | [1] S. H. Simon, The Oxford Solid State Basics (Oxford University Press, 2013).  [2] C. Kittel, Introduction to Solid State Physics (8th edition, John Wiley & Sons, New York, 2005).  [3] D. K. Ferry and J. P. Bird, Electronic Materials and Devices (Academic Press, 2001). |
| Grading Criteria  \*how would the students be assessed during the course. | Homework: 30% Midterm Exam: 30% Final exam (or report): 40 |

**Course Schedule**

Please complete the following table with the dates and expected course topics. If there are more than one lecturers instructing the course, please also indicate the lecturer for each class.

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| --- | --- | --- | --- |
| Class | Date (YYYY/MM/DD) | Course Topic | Lecturer |
| 1 | 2022/9/14(三) | Course introduction. | Sheng-Shiuan Yeh |
| 2 | 2022/9/21(三) | The wave mechanics of electrons: The Schrödinger equation. Particles in a 1D box. | Sheng-Shiuan Yeh |
| 3 | 2022/9/28(三) | The hydrogen atom. Quantum numbers. More on the hydrogen atom. | Sheng-Shiuan Yeh |
| 4 | 2022/10/5(三) | Many-electron atoms and the periodic table. Molecules. Bonding in molecules and solids. | Sheng-Shiuan Yeh |
| 5 | 2022/10/12(三) | Phonon I: Crystal vibrations. | Sheng-Shiuan Yeh |
| 6 | 2022/10/19(三) | Phonon II: Thermal properties. | Sheng-Shiuan Yeh |
| 7 | 2022/10/26(三) | Electrons in metals. The free-electron gas at absolute zero. More on the free-electron gas. The free-electron gas at non-zero temperature. | Sheng-Shiuan Yeh |
| 8 | 2022/11/2(三) | Dynamics of the free-electron gas. Electrons in crystals. Nearly-free electrons in crystals. Kronig-Penney model. | Sheng-Shiuan Yeh |
| 9 | 2022/11/9(三) | Midterm exam. | Sheng-Shiuan Yeh |
| 10 | 2022/11/16(三) | Atomic origins of energy gaps. Electron dynamics in energy bands. Effective mass of electrons in energy bands. Semiconductors. | Sheng-Shiuan Yeh |
| 11 | 2022/11/23(三) | Intrinsic semiconductors. Extrinsic semiconductors. Carriers in extrinsic semiconductors. | Sheng-Shiuan Yeh |
| 12 | 2022/11/30(三) | Carrier statistics in semiconductors. Carrier drift in semiconductors. Semiconductor band structure. | Sheng-Shiuan Yeh |
| 13 | 2022/12/7(三) | The pn Junction. pn Junction Electrostatics. Biasing of pn Junctions. Rectification in pn Junctions. | Sheng-Shiuan Yeh |
| 14 | 2022/12/14(三) | Metal-semiconductor junctions. The metal-oxide-semiconductor field-effect transistor (MOSFET). Insulators. | Sheng-Shiuan Yeh |
| 15 | 2022/12/21(三) | Dielectrics: A microscopic approach. Ferroelectricity and piezoelectricity. Magnetism and magnetic materials. | Sheng-Shiuan Yeh |
| 16 | 2022/12/28(三) | Diamagnetism and paramagnetism: A microscopic approach. Ferromagnetism. Magnetism: quantum-mechanical considerations. | Sheng-Shiuan Yeh |
| 17 | 2023/1/4(三) | Final exam (or report). | Sheng-Shiuan Yeh |