

|   |  |   |  |                             |            |                                    |  |  |
|---|--|---|--|-----------------------------|------------|------------------------------------|--|--|
| Subject (English)   | Materials Science and Engineering A  |   | Semester   | Fall*<br>Quarter<br>Subject | Day/Slot   | Thu. / 2 <sup>nd</sup> 10:30-12:00 |  |  |
| 科目名 (日本語)   | 材料科学 A   |   |  |                             |            | Fri. / 1 <sup>st</sup> 8:50-10:20  |  |  |
| Course Code   | VJ231F71   | Course Numbering  | TMA-MEE216   |                             | Period     | Nov.29, 2019 – Jan.31, 2020*       |  |  |
| Instructor (Post)   | Prof. Yutaka Watanabe  |   | *This is a <b>Quarter Subject</b> .<br>Make sure not to conflict with other courses. |                             |            | Campus                             | Aobayama   |  |
|   |  |   |  |                             |            | Building                           | <a href="#">Mechanical Engineering Research Bld. No. 2</a> |  |
| Faculty   | School of Engineering  |   | Credits  | 2                           | Class Room | 2-214 (2 <sup>nd</sup> floor)      |  |  |
| <b>Class subject</b>  |  |   |  |                             |            |                                    |  |  |
| <b>Object and summary of class</b>  |  |   |  |                             |            |                                    |  |  |
| This course will provide concise introduction to the microstructures and processing of materials and how these are related to the properties of engineering materials. In this course, although we mostly deal with metals, properties of other engineering materials will also be discussed. |  |   |  |                             |            |                                    |  |  |
| Keywords  | Equilibrium, Phase Diagram, Kinetics, Diffusive transformation, Displacive transformation, TTT diagram, Heat treatment of steels, Properties of alloys |   |  |                             |            |                                    |  |  |
| <b>Goal of study</b>  |  |   |  |                             |            |                                    |  |  |
| The goal of this course is understanding basic properties of materials, of how properties are related to microstructures, of how microstructures are controlled by processing, and of how materials are formed and joined.  |  |   |  |                             |            |                                    |  |  |
| <b>Contents and progress schedule of class</b>  |  |   |  |                             |            |                                    |  |  |
| No.   | Date   | Contents  |  |                             |            |                                    |  |  |
| 1   | 11/29  | Course Introduction and Orientation   |  |                             |            |                                    |  |  |
| 2   | 12/5   | Properties and Structures of Metals 1<br>- Generic metals and alloys / Design data  |  |                             |            |                                    |  |  |
| 3   | 12/6   | Properties and Structures of Metals 2<br>- Range of metal structures that can be altered to get different properties                        |  |                             |            |                                    |  |  |
| 4   | 12/12  | Equilibrium Constitution and Phase Diagrams<br>- Mixing elements to make an alloy can change their structure                                |  |                             |            |                                    |  |  |
| 5   | 12/13  | Case Studies in Phase Diagrams 1<br>- Phase diagrams  |  |                             |            |                                    |  |  |
| 6   | 12/19  | Case Studies in Phase Diagrams 2<br>- Examples; choosing soft solders, pure silicon for microchips, making bubble-free ice                  |  |                             |            |                                    |  |  |
| 7   | 12/20  | Driving Force for Structural Change<br>- Solidification, solid-state phase changes, precipitate coarsening, grain growth, recrystallization |  |                             |            |                                    |  |  |
| 8   | 1/9  | Kinetics of Structural Change 1<br>- Diffusive transformations  |  |                             |            |                                    |  |  |
| 9   | 1/10   | Kinetics of Structural Change 2<br>- Nucleation / Displacive transformations  |  |                             |            |                                    |  |  |
| 10  | 1/16   | Case Studies in Phase Transformation 1<br>- Artificial rain-making / Fine-grained castings  |  |                             |            |                                    |  |  |
| 11  | 1/17   | Case Studies in Phase Transformation 2<br>- Single crystals for semiconductors / Amorphous metals   |  |                             |            |                                    |  |  |
| 12  | 1/23   | Carbon Steels<br>- Structures produced by diffusive changes / Structures produced by displacive changes / TTT diagrams                      |  |                             |            |                                    |  |  |
| 13  | 1/24   | Alloy Steels<br>- Solution strengthening / Precipitation strengthening / Corrosion resistance   |  |                             |            |                                    |  |  |
| 14  | 1/30   | Production, Forming, and Joining<br>- Casting / Joining / Surface modification  |  |                             |            |                                    |  |  |
| 15  | 1/31   | Review and Final Exam   |  |                             |            |                                    |  |  |
| Preparation   | -  |   |  |                             |            |                                    |  |  |
| Record and evaluation method  | Evaluation will be based on "class participation and homework assignment" and "final exam".  |   |  |                             |            |                                    |  |  |
| Textbook and references   | M. F. Ashby and D. R. H. Jones, Engineering Materials 2, ELSEVIER  |   |  |                             |            |                                    |  |  |
| Self study  | -  |   |  |                             |            |                                    |  |  |
| In addition   | -  |   |  |                             |            |                                    |  |  |