

Elective Course Description (1. Fall Semester)

Subject (English)	Materials Science and Engineering A		Semester	Fall/Q* Quarter Subject	Day/Slot	
科目名 (日本語)	材料科学 A					
Course Code		Course Numbering	TMA-MEE216		Period	Dec. – Feb. (Quarter)
Instructor (Post)	Prof. Yutaka Watanabe				Campus	
					Building	
Faculty	Department of Mechanical and Aerospace Engineering		Credits	2	Class Room	
Class subject						
Object and summary of class						
<p>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.</p>						
Keywords	Equilibrium, Phase Diagram, Kinetics, Diffusive transformation, Displacive transformation, TTT diagram, Heat treatment of steels, Properties of alloys					
Goal of study						
<p>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.</p>						
Contents and progress schedule of class						
<ol style="list-style-type: none"> 1. Orientation 2. Properties and Structures of Metals <ul style="list-style-type: none"> ・Generic metals and alloys / ・Design data 3. Properties and Structures of Metals <ul style="list-style-type: none"> ・Range of metal structures that can be altered to get different properties 4. Equilibrium Constitution and Phase Diagrams <ul style="list-style-type: none"> ・Mixing elements to make an alloy can change their structure 5. Case Studies in Phase Diagrams <ul style="list-style-type: none"> ・Phase diagrams 6. Case Studies in Phase Diagrams <ul style="list-style-type: none"> ・Examples; choosing soft solders, pure silicon for microchips, making bubble-free ice 7. Driving Force for Structural Change <ul style="list-style-type: none"> ・Solidification, solid-state phase changes, precipitate coarsening, grain growth, recrystallization 8. Kinetics of Structural Change <ul style="list-style-type: none"> ・Diffusive transformations 9. Kinetics of Structural Change <ul style="list-style-type: none"> ・Nucleation / ・Displacive transformations 10. Case Studies in Phase Transformation <ul style="list-style-type: none"> ・Artificial rain-making / ・Fine-grained castings 11. Case Studies in Phase Transformation <ul style="list-style-type: none"> ・single crystals for semiconductors / ・Amorphous metals 12. Carbon Steels <ul style="list-style-type: none"> ・Structures produced by diffusive changes / ・Structures produced by displacive changes (martensite) / ・TTT diagram 13. Alloy Steels <ul style="list-style-type: none"> ・Solution strengthening / ・Precipitation strengthening / ・Corrosion resistance 14. Production, Forming, and Joining <ul style="list-style-type: none"> ・Casting / ・Plastic working / ・Joining / ・Surface engineering 15. Final exam 						
Preparation						
Record and evaluation method			Evaluation will be based on “class participation and homework assignment (30%)” and “final exam (70%)”.			
Textbook and references			Textbook: M. F. Ashby and D. R. H. Jones, Engineering Materials 2, ELSEVIER.			
Self study						
In addition						