Course Numbering	TME-MSE220J
Year	First semester 2026
Subject (J)	Materials Science and Engineering B
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Credit(s)	2Credits
Instructor	HONGMIN ZHU,TAKAHIRO MIKI,KATSUNARI OIKAWA
Media Class Subjects	
Essential Subjects	
Language of Instruction	English
Course Objectives and Summary/ Learning Goals (J)	The class code for Google Classroom can be found on the Web site of the School of Engineering: https://www.eng.tohoku.ac.jp/edu/syllabus-ug.html (JP Only) Objective This course focus on the principle of chemical thermodynamic of refining process of metals and specific knowledge of each process of various metals. Outline English is used in this class because this course combine with the course for foreign students of short term program. At first, we focus on principle of equilibria of chemical reaction of metal processing, and then refining process of steels, copper, aluminum and other metals to understand the basic procedure and chracteristic Outcomes Understand the thermodynamic equilibrium of metal refining process Understand the basic knowledge of various refining process of metals This course include the contents of our program outcomes of A, B, C, D, K
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Relevance to Other Subjects/Considerations for Taking the Class (J)	Physical chemistry for Materials I, Physical chemistry for Materials II
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Course Description (J)	I Thermodynamics for materials processing (K. OIKAWA) 1 Introduction of chemical metallurgy 2 Thermodynamic functions and reduction/oxidation equilibrium for materials 3 Ellingham diagram of chemical compounds 4 Prediction of equilibrium oxygen potential at the desired conditions 5 Prediction of heat needed for the given reaction II Pryometallurgy (T. MIKI) 6 Fundamentals of pyrometallurgy 7 Basic principle of iron and steelmaking 8 Iron- and Steelmaking process 9 Basic principle of copper smelting 10 Refining of copper and other metals

	III Hydrometallurgy and Electrometallurgy (H. ZHU) 11 Fundamentals of electrochemistry 12 Hydrometallurgy of zinc and other metals 13 Aluminum smelting 14 Active metal processing IV Summary 15 Final examination
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Preparation and Review(J)	Students required to make self-directed learning including review and preparations.
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Evaluation methods and criteria (J)	attendance to the class, home work and final Exam. (attendance to the class and report if the final exam can not be set by the trouble of corona virus)
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Textbooks and references

Title	Author	Publisher	Year	ISBN/ISSN	Classification
金属化学入門シリーズ1 金属物理化学	日本金属学会編		1996	4889030115	
金属化学入門シリーズ3 金属製錬工学	日本金属学会編		1999	4889030123	
Introduction to metallurgical thermodynamic	David R. Gaskell	McGrow-Hill		0070229457	
Principles of Extractive Metallurgy, Vol. 3 Pyrometallurgy	F. Habashi	Gordon and Breach		2881240410	
Aluminium Electrolysis -- Fundamentals of the Hall-Heroult Process	J. Thonstad			3870171294	

URL	材料科学総合学科学習教育到達目標 https://www.material.tohoku.ac.jp/department/purpose.html 材料科学総合学科カリキュラム http://www.material.tohoku.ac.jp/ugrad/curriculum.html
Attached File	
Office Hours(J)	Any time (Contact the lecture in advance)

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Contact： Please insert '@' in the email address.	研究科Webサイトに掲載されている連絡先一覧から確認すること。 Please check with the contact list posted on the Graduate School website.
Notes	記号A-Mについては、マテリアル・開発系の教育目標を参照してください。 https://www.material.tohoku.ac.jp/department/purpose.html
Practical Skill/Hands-on Class	
Other Comments/Instructions	
Last Update	2025/3/5

One-credit courses require 45 hours of study. In lecture and exercise-based classes, one credit consists of 15-30 hours of class time and 30-15 hours of preparation and review outside of class. In laboratory, practical skill classes, one credit consists of 30-45 hours of class time and 15-0 hours of preparation and review outside of class.