ADVANCED TECHNOLOGY (ADDITIVE MANUFACTURING) DEVELOPMENT IN ENVIRONMENTAL ENGINEERING

ENV/NTR/AGEO/SFW

Fall 2022

Course Code: **Course ID:**	
Enrollment Key	
Course Instructor:	**Dr. Kubatbek Muktarbek uulu**
Course Duration:	**17-18 Weeks**
No. of Credit Units:	**6.0**
Class meeting/Time: **Mode:** **Office Hours**	**Thursday 14:10 Friday 14:10** **OFFLINE** **By appointment**

Course Description

Humankind has been using materials such as metals, alloys, ceramics, glass, fibers for a long time. Such materials have continued to shape civilizations, cultures, and societies, as the latter experience recent advances in iron ore extraction, comminution, classification, and physical and physicochemical as well as biotechnological separation techniques. These advances give technological, developmental, and historical insights into iron ore agglomeration and blast furnace ironmaking technologies and how environmental issues and low-emission technologies relate to iron ore production and utilization.

This course will thus provide an overview of the historical, societal issues, and the scientific contexts in which such materials were developed, within the history of humankind and civilization as it relates to the use and development of these materials. The course is designed to integrate aspects of materials science, environmental engineering, reverse engineering, and additive manufacturing (3D printing). Reverse engineering encompasses the set of activities aimed at (re)discovering the functional, structural, and behavioral semantics of a given artifact, with the aim of leveraging this information for the efficient usage or adaption of that artifact, or the creation of related artifacts. Whereas additive manufacturing is referred to as 3D printing and rapid prototyping emerging as an important manufacturing technology. Additive manufacturing (AM) became a promising technology to manufacture complex structures with acceptable mechanical properties.

Learning Objectives/Outcomes:

In this course, students are expected to:

- explore a balanced approach in examining scientific principles, practical, and environmental engineering necessary for selecting the proper materials for modern technology and discuss topics of recent advances in reverse engineering techniques and tools.
- provide knowledge, understanding, and skills on material sciences, additive manufacturing (3D printing), environmental, and reverse engineering;
- prepare students by providing them information on the latest emerging technologies in additive manufacturing, environmental and reverse engineering; familiarizing with respective current practices and regulations;
- enable students apply knowledge and skills of environmental and reverse engineering in

disciplines, which include but not limited to software engineering, automotive, and medical device industries, and academic research.

Readings, Supplementary Materials & Assignments - To be posted on the e-course

1. Rolf E. Hummel, *Understanding Materials Science History, Properties, Applications*. Second Edition. Springer, Florida 2004.
2. Liming Lu, *Iron Ore Mineralogy, Processing and Environmental Sustainability*. Second edition. Woodhead Publishing is an imprint of Elsevier, Australia 2022.
3. James F. Shackelford, *Introduction to materials science for engineers.* Eighth edition. Pearson Higher Education, Inc., Upper Saddle River, NJ 07458, USA 2015.
4. Wego Wang, *Reverse engineering. Technology of reinvention*. CRC Press Taylor & Francis Group, USA 2011.
5. M. Adam Khan, J. T. Winowlin Jappes, *Innovations in Additive Manufacturing*. Springer, Switzerland 2022.
6. K.R. Balasubramanian, V. Senthilkumar, *Additive Manufacturing Applications for Metals and Composites*. IGI Global, USA 2020.

Course Requirements and their weight in the final grade:

Attendance/Participation	15%
Presentations on readings (in class)	20%
Midterm Exam	30%
Final Exam	35%
Total:	100%

General Course Outline and Schedule

(subject to change at instructor's discretion)

Week	Topic	Assignments
Week 1	**Introduction to the Syllabus and requirements** Overview of the course: Historical Background to Material Science and Engineering	Rolf E. Hummel, Understanding Materials Science History, Properties, Applications. Second Edition. Springer, Florida 2004.
Weeks 2-3	**The First Materials (Stone Age and Copper–Stone Age)** Ceramics and Civilization, History of Glassmaking, Cement, Concrete, and Plaster.	Rolf E. Hummel, Understanding Materials Science History, Properties, Applications. Second Edition. Springer, Florida 2004.
Weeks 4-6	**Introduction to ironmaking technologies** Blast furnace ironmaking fundamentals, Environmental sustainability and low emission technologies, Alternative ironmaking technologies	Liming Lu, Iron Ore Mineralogy, Processing and Environmental Sustainability. Second edition. Woodhead Publishing is an imprint of Elsevier, Australia 2022. Student presentations

Weeks 7-9	**Materials for Engineering.** Six Engineering Materials that changed the world, Atomic bonding, Crystalline Structure-Perfection, Diffusion, Mechanical Behavior.	James F. Shackelford, Introduction to materials science for engineers. Eighth edition. Pearson Higher Education, Inc., Upper Saddle River, NJ 07458, USA 2015. Student presentations
Week 10	**Midterm Exam**	
Week 11-12	**Materials for Engineering.** Six Engineering Materials that changed the world, Atomic bonding, Crystalline Structure-Perfection, Diffusion, Mechanical Behavior	
Week 13-14	**Reverse engineering, Technology of reinvention.** Industrial Evolution, Reverse Engineering in Modern Industries	Wego Wang, Reverse engineering. Technology of reinvention. CRC Press Taylor & Francis Group, USA 2011. Students Presentations
Weeks 15-16	**Additive Manufacturing Applications for Metals and Composites.** Introduction to Additive Manufacturing, Processes and Application in Additive Manufacturing: Practices in Aerospace, Automobile, Medical, and Electronic Industries	K.R. Balasubramanian, V. Senthilkumar, Additive Manufacturing Applications for Metals and Composites. IGI Global, USA 2020. Student presentations
Week 17	**Summary and Conclusion**	
Week 18	**Final Exam**	