Course Title	Manufacturing Materials and Engineering Design				
Course Code	MED501				
Course Type	Compulsory				
Level	Masters (2nd Level)				
Year / Semester	1st year / Fall Semester				
Teacher's Name	Prof. Dimitrios Manolakos, Prof. George Desmosthenous, Dr. Antonios Lontos				
ECTS	10	Lectures / week	3	Laboratories/week	
Course Purpose	This course introduces materials processing from the perspective of the designer engineer. The purpose is to present in the available manufacturing materials for a wide range of constructions and products in engineering applications. Following this course, the students will have a deep understanding of the methodology of materials selection, use of computer-aided selection and material data and knowledge sources and their usefulness. At the end of the course, the students will learn to implement engineering products and designs based on appropriate material selection from a variety of material choices.				
Learning Outcomes	By the end of the course, students must be able to: 1. Distinguish various classes of advanced materials. 2. Describe general material properties and their relation to product and component design. 3. Combine most suitable material that would give the required properties of an engineering product. 4. Interpret new terms and information on super alloys, super hard materials, bearing alloys, tool steels and ceramics. 5. Improve their knowledge of various classes of advanced materials. 6. Distinguish materials suitable for application at elevated temperatures and identify coatings suitable for protection applications. 7. Demonstrate knowledge of various materials characterization techniques.				
Prerequisites	None			Corequisites	None
Course Content	1. Advanced Material properties Atomic structure, crystal structure, imperfections, diffusion, mechanical properties, dislocations and strengthening mechanisms, phase diagrams, phase transformations, solidification, corrosion. Range of applications, Choice of materials, Types of materials, The materials selection process, Material properties, Ceramics, Tool steel, Super hard materials, Super alloys (Iron base, Ni-Cr alloys, Nickel base and Cobalt				

	base), Non-metallic materials – polymers and composites. 2. Materials selection Manufacturing materials selection and engineering design procedures. Check lists. Elementary stressing calculations. Choice of fabrication techniques. Case studies. Data sources. Material selection group exercise. Material selection individual exercise. 3. Structural and pipeline steels Structural steels, specifications and influence of composition, heat treatment and microstructure on mechanical properties. Fracture, weldability and the influence of welding on mechanical properties. Processing grain refinement, thermomechanical treatment and accelerated cooled steels (TMCP) - effect of composition, inclusions, grain size and production route on mechanical properties. 4. Corrosion resistant materials Stainless steels - austenitic, ferritic, martensitic and duplex stainless steels - compositions, microstructures and properties. 5. Specific metals and alloys Applications and potentialities of metals and alloys in a wide variety of engineering environments. Specific metals and alloys both for general use and for more demanding applications. Titanium, nickel and magnesium based alloys, intermetallics, steels. The design of alloys, current developments in the field of light alloys, steels, high temperature materials. aerospace aluminium alloys: precipitation hardening, effect of precipitates on mechanical properties, designation of aluminium alloys, alloys based on Al-Cu, alloys based on Al-Zn. Industrial applications. 6. Specific polymers and composites The structure, properties, processing characteristics and applications for the commercially important polymers. General classes of polymers: commodity, engineering and speciality thermoplastics, thermosetting resins, rubbers. Variation in behaviour within families of polymers: crystallinity, rubber toughened grades; reinforced and filled polymers. 7. Applications of advanced materials Classes of materials used in automotive, aerospace, energy renewable technologies and medical.
Teaching Methodology	Teaching methods are based on problem-based learning, cases-based learning and the use of eLearning platform and online sources. All these approaches are related to a more active student-centred education. Lecture notes and presentations are available through the web for students to use in combination with the textbooks. Furthermore, theoretical principles are explained by means of specific examples and solution of specific problems.
Bibliography	**Textbook** 1. Serope Kalpakjian, Steven Schmid, Manufacturing Processes for Engineering Materials, Pearson, 2017

	References 1. Chander Prakash, Sunpreet Singh, Paulo Davim, Advanced Manufacturing and Processing Technology, CRC Press, 2020 2. Leonid Burstein, Handbook of Research on Advancements in Manufacturing, Materials, and Mechanical Engineering, Engineering Science Reference, 2020 3. Mokhtar Awang, Seyed Sattar Emamian, Advances in Material Science and Engineering: Selected articles from ICMMPE 2020, Springer, 2021 4. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, Pearson, 2020 5. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2nd edition, 2004. 6. Mahmoud M. Farag, Materials and Process Selection for Engineering Design, CRC Press, 2020 7. Groover, Mikell P., Fundamentals of Modern Manufacturing Materials - Processes and Systems, New York John Wiley & Sons, 2007 8. Richard A Flinn, Engineering Materials and Their Applications Publishing House, Revised edition, 2006 9. Henkel and Pense, Structure and properties of engineering materials, fifth edition, McGraw Hill, 2002 10. William D. Callister, Jr. and David G. Rethwisch. Materials Science and Engineering an Introduction, Eighth Edition, John Wiley & Sons, Inc. 11. A.K Bhargava, Engineering Materials: Polymers, Ceramics and Composites, Prentice Hall of India
Assessment	1. Assignments 40% 2. Final Exam 60%
Language	English