Course Title	Advanced Welding Processes				
Course Code	MED506				
Course Type	Elective				
Level	Masters (2nd Level)				
Year / Semester	1st year / Spring Semester				
Teacher's Name	Dr. Ioannis Kordatos				
ECTS	10	Lectures / week	3	Laboratories/week	
Course Purpose	The course purpose is to provide students with an advanced knowledge of the most recent developments in welding processes in order to decide which is the most suitable for certain engineering product. Upon completion of this course, the students will be able to develop skills on laser welding, as well as recent developments in arc, friction and resistance welding. The course will cover the operating principles, characteristics and practical applications of each process.				
Learning Outcomes	By the end of the course, students must be able to: 1. Improve their understanding about recent developments in welding technology and where these processes can be used. 2. Maximise process efficiency by understanding the physical and engineering principles behind each method and their applications. 3. Describe physical and engineering principles behind selective applications for welding processes and critique methods for maximising process efficiency. 4. Appraise recent developments in welding technology and identify where these new processes can be used. 5. Develop skills in evaluation and assessment welded parts. 6. Design a welding procedure for engineering parts and estimate the time to manufacture. 7. Calculate the cost of a typical robotic welding operation including labour costs, overhead costs, and consumable costs.				
Prerequisites	None			Corequisites	None
Course Content	1. Laser welding including micro-welding and hybrid processes Fundamentals of lasers, optics and fibre optics, Laser properties, Optics and optical materials, material interaction, welding including hybrid processes, cutting and drilling, surface treatment, material processing systems, Material characteristics and response to laser, Laser safety. 2. Solid state welding processes Flash, Stud, High Frequency, Cold Pressure, Ultrasonic, Diffusion,				

	Explosion (Coating and Cutting), Welding and Variants. 3. Friction stir welding Solid-state metal joining process, High-strength, defect free joints, Metallic parts and materials, Pin tools, Residual stresses, Flexible joints, Deformation, Shrinkage and porosity, Automated processes, Complex geometries. 4. Repair welding Welding procedure, specific filler metals, preheating, welding joint techniques, Residual stress, distortion and their management, Welding equipment, welding equipment, electrode holders, grinders, wire feeders, Materials, filler metals for repair, insert pieces, reinforcing pieces, shielding gases, Welding sequences, back-step sequence welding, wandering sequence welding and peeling. health and safety, Ventilation, Weld Quality. Quality standards, organizational policies and procedures, inspection of equipment, continually checked. grinding and smooth flowing contours. 5. Robotics systems in welding Welding program structure and operation including straight line, circles, and weaving fundamentals, programming and operating the robot system, programming languages and menu structures, adjustments to weld points, Program weld commands and parameters. 6. Advanced digital arc welding, flux cored arc welding 7. Advanced modelling and monitoring of resistance welding
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. Roger Timings, Fabrication and Welding Engineering, Elsevier, 2008 **References** 1. Kapil Gupta, J. Paulo Davim, Advanced Welding and Deforming, 2021 2. M. Miller, Robots and Robotics: Principles, Systems, and Industrial Applications, McGraw Hill, 1st Edition, 2017 3. Seiji Katayama, Fundamentals and Details of Laser Welding (Topics in Mining, Metallurgy and Materials Engineering), Springer, 2020 4. Mukti Chaturvedi, S. Arungalai Vendan, Advanced Welding Techniques: Holistic View with Design Perspectives, Springer, 2021 5. Lucas F. M. da Silva, Paulo A. F. Martins, Mohamad S. El-Zein, Advanced Joining Processes, Springer, 2020 6. Welding Institute Canada, Welding for Challenging Environments, Pergamon Press, 1996 7. Mishra R. S, Mahoney M. W, Friction Stir Welding and Processing, ASM, 2007

	8. John G. Hicks, Welded Joint Design, Woodhead Publishing, 1999 9. Larry Jeffus, Welding: Principles and Applications, Delmar Seangage Learning, 2012 10. William L. Galvery Jr. and Frank B. Marlow, Welding Essentials, Industrial Press Inc, 2007 11. Andrew D. Althouse, Carl H. Turnquist, William A. Bowditch and Kevin E. Bowditch, Modern Welding, 2012 12. Sindo Kou, Welding Metallurgy, Wiley, 2002 13. Hallock Cowles, Certification Manual for Welding Inspectors, AWS, 2000
Assessment	1. Assignments 40% 2. Final Exam 60%
Language	English