FREDERICK UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING

«MSc in MANUFACTURING AND WELDING ENGINEERING DESIGN»

Specializations:
a) Manufacturing Engineering Design
b) Welding Engineering Design

General Objectives

The aim of this MSc programme is to provide advanced knowledge and scientific background such that our engineering graduates, based on the knowledge gained from this programme, can enter the mechanical engineering industry successfully and use this knowledge to become experts in certain active areas or disciplines.

Furthermore, this MSc programme will broaden, strengthen and integrate knowledge and understanding regarding advanced engineering industry processes. This will include all the necessary academic tools, computational modelling techniques, design, and engineering practice to solve mechanical engineering problems of varying complexity, taking into consideration the economic, social and environmental context.

At the end of this programme, a deep and broad knowledge of the advanced mechanical engineering technology will have been acquired, enabling the prediction, improvement and innovativeness of the processes of modern mechanical engineering design and production activities.

Two Specializations

1. Specialization in Manufacturing Engineering Design

Specialization in Manufacturing Engineering Design include courses which are designed to provide advanced competencies in the areas of computer-aided manufacturing, computer-aided design and analysis, and integrated processing of various materials. It is designed for decision-makers in manufacturing engineering, engineering graphics and design, process engineering, quality assurance, and tooling design.

2. Specialization in Welding Engineering Design

Specialization in Welding Engineering Design will provide graduates with a fundamental understanding of welding technologies and an awareness of recent technical developments within the relevant industries. It will also improve communication, presentation, analytical and problem solving skills. Our graduates will obtain high level education gain in advanced welding and joining technologies, thus be able to attain positions of significant engineering responsibility

Program Structure

The programs consist of three semesters. At the second semester the students will have to select one of the two specializations. 5 common core courses, 4 specialization courses, 3 courses which constitute the MSc Thesis.

	ECTS
Required	30
Specialization courses	30
MSc Thesis	30
Total	**90**

Each course is individually evaluated according to attendance, Midterm exams, Homework Assignments, Projects: Research/Report/ Presentations and Final Exams.

Duration of the programme

The duration of the MSc Programme is 18 months (i.e. three semesters) for full time or 30 months (i.e. five semesters) for part time attendance.

A/A	Course Type*	Course Code	Course Title	Teaching Periods per Week		ECTS
				Theory	Laboratory	
1	Required	MDME501	Design and Manufacturing	2	1	7
2	Required	MDME502	Advanced CAD/CAM Systems	2	1	7
3	Required	MDME503	Advanced Materials and Applications	2	1	7
4	Required	MDME504	Graduate Seminars I	2	-	2
5	Required	MDME506	Design of Welded Structures	2	1	7
6	Spec Elect	MDMD505	Advanced Manufacturing processes	2	1	8
7	Spec Elect	MDMD510	Surface Engineering and Coatings	2	1	7
8	Spec Elect	MDMD512	Rapid Product Development	2	1	7
9	Spec Elect	MDMD513	Advanced Engineering Design	2	1	8
10	Spec Elect	MWED505	Welding Processes and Equipment	2	1	8
11	Spec Elect	MWED510	Welding Metallurgy and Weld Quality	2	1	8
12	Spec Elect	MWED512	Advanced Welding Processes	3	-	7
13	Spec Elect	MWED513	Welding Systems and Research Methods	3	-	7
14	Required	MDME 516	Research Preparation and Proposal	-	-	7
15	Required	MDME517	Graduate Research	-	-	13
16	Required	MDME518	Thesis Writing and Presentation	-	-	10

Year 1 - Semester 1

Course code/Title	ECTS	Hours
MDME 501 - Design and Manufacturing	7	2+1*
MDME 502 - Advanced CAD/CAM Systems	7	2+1*
MDME 503 - Advanced Materials and Applications	7	2+1*
MDME 504 - Graduate Seminars I	2	-
MDME 506 - Design of Welded Structures	7	2+1*
Total	**30**	

Year 1 - Semester 2

- (1) Specialization in Manufacturing Engineering Design

Course code/Title	ECTS	Hours
MDMD 505 - Advanced Manufacturing processes	8	2+1*
MDMD 510 - Surface Engineering and Coatings	7	2+1*
MDMD 512 - Rapid Product Development	7	2+1*
MDMD 513 - Advanced Engineering Design	8	2+1*
Total	**30**	

Year 1 - Semester 2

- (2)Specialization in Welding Engineering Design

Course code/Title	ECTS	Hours
MWED 505 - Welding Processes and Equipment	8	2+1*
MWED 510 - Welding Metallurgy and Weld Quality	8	2+1*
MWED 512 - Advanced Welding Processes	7	3
MWED 513 - Welding Systems and Research Methods	7	3
Total	**30**	

Year 1 - Semester 3

Course code/Title	ECTS	Hours
MDME 516 - Research Preparation and Proposal	7	-
MDME 517 - Graduate Research	13	-
MDME 518 - Thesis Writing and presentation	10	-
Total	**30**	

1. MDME501 - Design and Manufacturing

Embodiment Design, Selection of Materials, Review of Manufacturing Processes, Design for Casting, Bulk Deformation Processes, Sheet Metal Forming Processes, Machining, Powder Metallurgy, Polymer Processing, Quality, Reliability, Optimization

2. MDME502 - Advanced CAD/CAM Systems

CNC technology, CNC programming concepts, Generation of NC programs through manual programming, Advanced programs with canned cycles, Modern developments, Subprograms and program section repeats, Parametric programming, Macros, Computer Aided Design, Modern design and manufacturing. Geometric modelling, Computer Aided Manufacturing, Integrated CAD/CAM organization, CNC codes from CAD models, post processors, Modern CAD/CAM systems

3. MDME503 - Advanced Materials and Applications

Advanced materials, Properties of advanced materials, Materials selection process, Material properties, Ceramics, Tool steel, aluminum and magnesium alloys, Super hard materials, Super alloys, Non-metallic materials – polymers and composites, Applications of advanced materials (Automotive, Aerospace, Energy renewable technologies and Medical). Materials characterization techniques, scanning electron microscopy, transmission electron microscopy, atomic force microscopy.

4. MDME504 - Graduate Seminars I

To complete the requirements of this course, students must attend a number of research or scientific events such as seminars, talks and conferences. To satisfy these requirements, the student must attend at least six talks or its equivalent. For the purpose of this course, one-day seminars count as two talks, while conferences count as two talks per day. Students may attend scientific talks in the context of their specialization, organized either by the department, or by other institutions or universities.

5. MDME506 - Design of Welded Structures

Weld design, Joint design, welding symbols and standards, Welded structures under different types of loading, Design of welded structures under static loading and dynamic loading, Fatigue life and breakdown, Fracture mechanics to welded structures, Fatigue of welded structures, Stress concentrations, Weld defects, Welding residual stresses, Design for dynamic loading, Design for thermodynamic loading, Design of lightweight structures, Reinforcing, Steel welded joints, Assessment of structural integrity.

6. MDMD505 - Advanced Manufacturing processes

Advanced material removal processes, Machining and turning centers, Machine-Tool Structures, High-speed Machining, Hard Machining, Specification and selection of Machine Tools, Advanced Forming and Shaping Processes. Metal-Forging Processes, Die Design, Metal Extrusion, Hot and cold Extrusion, Powder Metal Processing and Equipment, Advanced Casting Processes and Equipment, Casting Processes, Permanent-mold, Casting Processes, Inspection of Castings, Melting Practice and Furnaces, Design Considerations in Casting, Casting Alloys, Electrical discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Abrasive jet maching (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM) and Electro discharge machining (EDM).

7. MDMD510 - Surface Engineering and Coatings

Surface engineering as a design process, Surface engineering processes, Adding a new material to the surface in the form of a coating, Characterization of coatings and thin films, Structural characterization, Non-destructive defect characterization, Tribological characterization, Quality in surface engineering, Industrial applications in Aerospace, Automotive, Biomedical, Marine, Electrical – Electronic, Printing industry, Selection of surface engineering techniques

8. MDMD512 - Rapid Product Development

Rapid Prototyping process, 3D Shape Technologies, 3D modelling, 3D laser scanners and surface generation, Computer tomography and Solid creation, Rapid Prototyping Techniques, Stereolithography, 3D models from liquid photosensitive polymers, Stereolithography apparatus (SLA) machines, Laminated Object Manufacturing, Adhesive-coated sheet material, Selective Laser Sintering, Liquid, solid and powder based rapid prototyping, RP applications in engineering, analysis and planning, Applications in manufacturing and tooling, aerospace, automotive, biomedical, Jewellery industry, Accuracy improvement and surface finish, Use of new materials non-polymeric materials, metals, ceramics and composites.

9. MDMD513 - Advanced Engineering Design

Factors influencing a Design/Project, Engineering tools such as CAD-CAM-CAE and others, Production/construction tools, controls including quality control, computer support, Design Connections, Generic functions and general behaviour, material connections, form connections, Mechatronics, General architecture and terminology, Adaptronics, Design/Project Phases, preparation phase, planning, execution phase, adaptation, Modelling, dynamics and optimal performance, Design/Project Management Methods and Tools, concurrent engineering, simultaneous engineering, SWOT analysis, Scheduling techniques, Design/Project Analysis and Financial Indices, Conditionally constraint and conditionally variable operational costs (i.e. personnel costs, operating costs marketing costs, maintenance costs) and human related factors

10. MWED505 - Welding Processes and Equipment

Process principles of GTAW, Advanced GTAW, Equipment for GTAW, Plasma arc welding and cutting, Metal transfer in consumable electrode processes, Process\ principles, operation and application of manual metal arc welding, Submerged arc welding, Electroslag welding, Electrogas welding, Gas metal arc welding, Pressure welding, ultrasonic welding, explosive welding, diffusion bonding, Stud welding/mechanical fasteners, Resistance welding, Oxy-fuel gas welding, Thermal cutting and other edge preparation processes, Surfaces and spraying, Magnetically impelled arc welding

11. MWED510 - Welding Metallurgy and Weld Quality

Metallographic examinations, Welding of aluminium, copper, and nickel based alloys, Joining dissimilar metals, Welding of castings – cast steel and cast iron, Wear and Protective Layers, Welding of Stainless Steels, Joining materials for low and high temperature applications, Joining of coated steels, Joining processes for plastics, Joining processes for advanced materials – ceramics and composites, Weld quality standards, Quality control during manufacture – weld procedure specification and qualification, Welder qualification, Introduction to Non-destructive examination (NDE) and types of weld imperfections, Fundamentals of NDE methods (dye penetrant, magnetic particle, eddy current, acoustic emission, radiographic inspection), Ultrasonic Inspection, Qualification and certification of NDE personnel, Health and Safety

12. MWED512 - Advanced Welding Processes

Laser properties, fundamentals and types, Laser optics and optical materials, Laser material interaction, Laser welding including hybrid processes, Laser cutting and drilling, Laser surface treatment, Laser material processing systems, Advanced digital arc welding, Flux cored arc welding, Advanced modelling and monitoring of resistance welding, Friction stir welding, Additive manufacture.

13. MWED513 - Welding Systems and Research Methods

Fundamentals of welding automation, Welding sensors and data acquisition, Welding process optimisation, Principles of robotic welding, Welding software, Project management, Critical evaluation of literature, Design and analysis of experiments, Evaluation and industrial implementation of research data, Welding and cutting laboratory, Economics of weld fabrication, Plant facilities, welding jigs and fixtures.

14. MDME 516 - Research Preparation and Proposal

The student must submit and present to his Assessment Committee a proposal for his Master's Thesis. In this proposal, the student is expected to propose the topic of his project, providing the detailed objectives and expected contributions of his work, give a complete literature review of the current state of knowledge on the issues related to the proposal, and suggest a methodology and planning for the implementation of the Thesis.

15. MDME517 - Graduate Research

The student is expected to implement the objectives of the Thesis, using the methodology proposed in the MME516 (Research Preparation and Proposal) course, according to the approved planning. For a typical full time student, this course is taken concurrently with the MME518 (Thesis Writing and Presentation).

16. MDME518 - Thesis Writing and Presentation

After conducting their research work, students are expected to deliver a detailed project report that describes their research work and also present their project outcomes to their project Assessment Committee, as well as defend their work during an oral presentation. This course is graded in conjunction with the Graduate Research (MDME517). Both courses are assigned the same grade.

Manufacturing Technology and Engineering Design Laboratory (MTED)

The Manufacturing Technology and Engineering Design Unit aims to conduct high level of research in the field of manufacturing and engineering design of new and innovative products. Throughout various research projects the research team of the Center solved many problems of the local industry. The state of the art research facilities of the Center consist of various research equipment, devices and machines such as 5-axis high speed CNC vertical milling machine, rapid prototyping machine, fatigue tester, press machine, electronic microscope precision-controlled heat-treatment furnaces, materials characterization instruments, etc. Furthermore, the research team uses a number of CAD/CAM/CAE software packages such as LS-DYNA, DEFORM3D, ANSYS, COSMOS, Nastran etc. for making calculation, simulations and solid modeling.

Research Projects:

- Application of thin hard PVD, CVD and Thermal Spray coatings on machine elements (extrusion dies, cutting tools, hybrid bearings, cam mechanisms)
- Characterization and evaluation of the mechanical properties of hard and thin PVD, CVD and thermal spray coatings, fatigue prospect and determination of their working life under static or dynamic loads
- Design and development of computational procedures by means of Finite Elements Method (FEM Simulation)
- Manufacturing processes, CNC machine tools and CAD/CAM systems
- Reconstruction of Archaeological Findings by Computer Tomographies and Rapid Prototyping Methods
- Design and manufacturing of fiber-reinforced composite high-pressure pipes capable for corrosion liquids
- Bio-engineering, Spine simulation (FEM), Material Properties and Characterization

Laboratory of Computational Biomechanics (LCB)

The Laboratory of Computational Biomechanics was officially established as an independent and self-funded research entity in 2013. The teams' research activities however, precede its foundation by almost two years. Mainly focusing on Inverse Dynamics and Finite Element simulations of the Human Musculoskeletal system, the Laboratory of Computational Biomechanics rigorously publishes breakthroughs in related fields and internationally recognized journals. Members of the Laboratory participate both, in national and inter-European projects while having being awarded 4 scholarships and 2 awards in the last year only. During 2013, the team was nominated among the 3 finalist worldwide for the biannual «Clinical Biomechanics Award» of the International society of Biomechanics (ISB).

Research Projects:

- FEM supported determination of the biomechanical response of the human spine considering all muscelo-sceletal characteristics, Acronym: BioSpine, Project ID: 3227, Greek Ministry of Education, Lifelong Learning and Religious Affairs, "Support of Postdoctoral Researchers", Sub filed: PE8 (Materials engineering, biomaterials, metals, ceramics, polymers, composites), Hellenic Host: Aristotle University of Thessaloniki, International Host: Frederick University, Budget 150.000, 2012-15
- "Optimizing the diagnostic value of SPECT myocardial perfusion images under the influence of respiratory motion", Βελτιστοποίηση της διαγνωστικής αξίας εξετάσεων αιμάτωσης μυοκαρδίου με υπολογιστική τομογραφία εκπομπής φωτονίων υπό την επίδραση της αναπνοής, Cyprus Research Promotion Foundation, ΥΓΕΙΑ/ΔΥΓΕΙΑ/0311(BIE)/27, Budget 180.000, 2012-14

Thank you for your attention