Mathematics II – Advanced Calculus

1. GENERAL			
SCHOOL	Faculty of Sciences in collaboration with Faculty of Engineering, Aristotle University of Thessaloniki		
DEPARTMENT	Materials Science and Engineering		
LEVEL OF STUDIES	ISCED level 7 (5-year Integrated Master's programme) ISCED level 6 (4-year BSc programme)		
COURSE CODE	**MSEN 303**	**SEMESTER**	3rd Semester
COURSE TITLE	**Mathematics II – Advanced Calculus**		
TEACHING ACTIVITIES Lectures, tutorials/problem sessions, laboratory/computer exercises (where applicable), case studies and guided self-study.		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
		4	6
COURSE TYPE	This course introduces statistical methods and data analysis techniques essential for understanding, modeling, and interpreting experimental and industrial data in materials engineering. Emphasis is placed on practical applications, decision-making, and quality control in material processes.		
PREREQUISITES	Students are expected to have: Mathematics I & II – A solid foundation in algebra, calculus, and differential equations. Basic knowledge of materials engineering concepts – Understanding of material properties, mechanical behavior, and experimental methods. Familiarity with basic computing skills – Using spreadsheets or software for simple calculations and data handling.		
TEACHING AND EXAMINATION METHODS	Lectures, Homework assignments, Quizzes, Midterm examination, Final exam		
COURSE OFFERED TO ERASMUS STUDENTS	Yes.		
COURSE URL	https://elearning.auth.gr/course/view.php?id=xxxxx		

2. LEARNING OUTCOMES	
Learning Outcomes	Students will be able to apply advanced calculus, vector calculus, and differential equations to model and analyze materials engineering systems. They will perform multivariable optimization, evaluate multiple integrals, solve ODEs and PDEs, use Laplace transforms, and apply numerical methods to solve engineering problems, interpreting mathematical results in the context of heat transfer, diffusion, stress analysis, and material behavior.
General Skills	By the end of the course, students will develop advanced problem-solving, analytical thinking, and quantitative reasoning skills, apply mathematical modeling to materials engineering problems, use

	computational tools effectively, and communicate mathematical results clearly in engineering contexts.

3. COURSE CONTENT

This course introduces statistical methods and data analysis techniques essential for materials engineering. Topics include descriptive statistics, probability, inferential statistics, correlation and regression, ANOVA, and statistical quality control. Emphasis is placed on applying these methods to analyze experimental data, predict material behavior, optimize processes, and support decision-making. Students also learn to use computational tools for data visualization, simulation, and statistical analysis.

4. LEARNING & TEACHING METHODS - EVALUATION

Teaching method	Face-to-face.
Use of ICT	ICT plays a significant role in enhancing teaching, learning, experimentation, visualization, and assessment in this course as follows: **Computational Tools for Problem Solving:** Spreadsheet calculations (Excel, Google Sheets), Coding solutions in Python, MATLAB, or Mathematica **Online Learning Platforms:** Learning management systems (LMS) like Moodle, Online lectures, video tutorials, and animations, **Communication and Collaboration:** Online discussion forums, Collaborative documents, Sharing of data and reports **Presentation and Reporting Tools:** Lab reports (word processors), Data plots and charts (graphing tools), Presentations (PowerPoint, Google Slides).
Teaching organization	The supervised and unsupervised workload per activity is indicated below (total workload complies with ECTS standards).

Activity	Workload/semester (hours)
Lectures	52
self-study, quizzes, on-line tests	46
Independent study	50
Final written exam	2
Total	**150**

Student evaluation	Assessment Language: English • Assessment Methods: Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Written Exams

5. SUGGESTED BIBLIOGRAPHY

Course Bibliography

Statistical Methods for Materials Science 1st Edition | ISBN 978-0367780289 | CRC Press, 2021

Additional bibliography for study

Materials Data Science | ISBN: 978-3-031-46564-2 | Springer 2024