

Course Manual HIM

Advanced Mathematics

Version: 3 | Last Change: 28.09.2019 11:58 | Draft: 0 | Status: vom verantwortlichen Dozent freigegeben

– General information

Long name	Advanced Mathematics
Approving CModule	HIM_MaCSN , HIM_MaET , HIM_MaTIN
Responsible	Prof. Dr. Heiko Knospe Professor Fakultät IME
Valid from	summer semester 2021
Level	Master
Semester in the year	summer semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Heiko Knospe Professor Fakultät IME Prof. Dr. Hubert Randerath Professor Fakultät IME Prof. Dr. Beate Rhein Professor Fakultät IME
Requirements	Differential and integral calculus and linear algebra (Bachelor-level mathematics)
Language	German and English
Separate final exam	Yes

Literature

K. Burg, H. Haf, F. Wille, A. Meister, Vektoranalysis - Höhere Mathematik für Ingenieure, Naturwissenschaftler und Mathematiker, Springer Vieweg

E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons

L. Papula, Mathematik für Ingenieure und Naturwissenschaftler Band 3, Springer Vieweg

R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, Probability & Statistics for Engineers & Scientists, Prentice Hall

S. M. Ross, Probability and Statistics for Engineers and Scientists, Elsevier

S. M. Ross, Stochastic Processes, John Wiley & Sons

U. Krengel, Einführung in die Wahrscheinlichkeitstheorie und Statistik

A. Koop, H. Mook, Lineare Optimierung, Springer

R. Reinhardt, A. Hoffmann, T. Gerlach, Nichtlineare Optimierung, Springer

M. Ulbrich, S. Ulbrich, Nichtlineare Optimierung, Birkhäuser

Final exam

Details

Written Exam

Minimum standard

Passing the exam

Exam Type

EN Klausur

– Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	<p>A combination of:</p> <ul style="list-style-type: none">- Vector Analysis- Probability Theory, Statistics and Multivariate Statistics- Stochastic processes- Optimization <p>Vector Analysis</p> <ul style="list-style-type: none">- Vector Spaces- Scalar and Vector Functions- Differential Operators- Line Integrals- Double Integrals- Triple Integrals- Change of Variables- Surface Integrals- Divergence Theorem- Theorem of Stokes- Maxwell Equations <p>Probability and Statistics</p> <ul style="list-style-type: none">- Descriptive Statistics- Two-dimensional Data- Simple Linear Regression- Probability Spaces- Random Variables- Expectation, Variance, Moments- Jointly Distributed Random Variables- Independent Random Variables- Covariance- Binomial Random Variable- Poisson Random Variable- Uniform Random Variable- Normal Random Variable- Chi-Square Distribution- t-Distribution- Central Limit Theorem- Distributions of Sampling Statistics- Confidence Intervals- Hypothesis Testing- t-Test, f-Test, Chi-Square Test- Overview of various Tests <p>Multivariate Statistics</p> <ul style="list-style-type: none">- Analysis of multidimensional data- Multivariate Random Variables- Matrix decompositions, Singular Value Decomposition (SVD)- Factor analysis, Principal Component Analysis (PCA)- Multiple Linear Regression

Special requirements

none

Accompanying material	Lecture Notes, Exercises and Solutions
------------------------------	--

Separate exam	No
----------------------	----

Stochastic Processes

- Discrete and continuous time processes
- Random walk
- Markov chain
- Poisson process
- Queuing theory

Optimization

- Linear Programming
- Unconstrained Optimization: Gradient method, Newton's method, Trust Region method
- Constrained Optimization: Karush–Kuhn–Tucker (KKT) conditions, Lagrange multipliers, Penalty and Barrier functions
- Special optimization problems: Mixed Integer Nonlinear Programming, Nonlinear Stochastic Optimization

Skills

-

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	3
Exercises (whole course)	1
Exercises (shared course)	0
Tutorial (voluntary)	0