

Module Handbook

TUK MODHB Homepage

Module MAT-00-03A-M-1

Higher Mathematics: Vector Analysis and Differential Equations (for Engineering Students)
(M, 8.0 LP)

Module Identification

Module Number	Module Name	CP (Effort)
MAT-00-03A-M-1	<i>Higher Mathematics: Vector Analysis and Differential Equations (for Engineering Students)</i>	8.0 CP (240 h)

Basedata

CP, Effort	8.0 CP = 240 h
Position of the semester	1 Sem. in WiSe
Level	[1] Bachelor (General)
Language	[DE] German
Module Manager	Pinnau, René, Prof. Dr. (PROF DEPT: MAT)
Lecturers	The Lecturers of the department Mathematics
Area of study	[MAT-Service] Mathematics for other Departments
Reference course of study	[MV-82.103-SG] B.Sc. Mechanical Engineering
Lifecycle-State	[NORM] Active

Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V+1U	MAT-00-032-K-1	P	U-Schein	PL1	4.0	WiSe
2V+1U	MAT-00-031-K-1	P	U-Schein	PL1	4.0	WiSe

- About [MAT-00-032-K-1]: Title: "Higher Mathematics: Vector Analysis (for Engineering Students)"; Presence-Time: 42 h; Self-Study: 78 h

- About [MAT-00-032-K-1]: The study achievement "[U-Schein] proof of successful participation in the exercise classes (ungraded)" must be obtained.
 - It is a prerequisite for the examination for PL1.
- About [MAT-00-031-K-1]: Title: "Higher Mathematics; Differential Equations (for Engineering Students)"; Presence-Time: 42 h; Self-Study: 78 h
- About [MAT-00-031-K-1]: The study achievement "[U-Schein] proof of successful participation in the exercise classes (ungraded)" must be obtained.
 - It is a prerequisite for the examination for PL1.

Examination achievement PL1

- Form of examination: **written exam (Klausur) (90 Min.)**
- Examination Frequency: each semester
- Examination number: 81015 ("Higher Mathematics: Vector Analysis and Differential Equations")

Evaluation of grades

The grade of the module examination is also the module grade.

Contents

From [MAT-00-032-K-1] Higher Mathematics: Vector Analysis (for Engineering Students):

- parametrization of curves and surfaces in \mathbb{R}^n ,
- computation of surface and (scalar and vectorial) curve integrals in \mathbb{R}^n ,
- tangent spaces and differential,
- classic operators on vector fields: div, rot, grad,
- integral theorems of Gauss and Stokes, Green's formulas, applications in \mathbb{R}^3 .

From [MAT-00-031-K-1] Higher Mathematics; Differential Equations (for Engineering Students):

Basic concepts for the treatment of ordinary and partial differential equations:

A. Ordinary differential equations:

- first-order differential equations: existence and uniqueness, first-order autonomous differential equations, separation approach, variation of constants, explicitly solvable cases, initial value problems;
- linear differential equations: homogeneous linear systems, matrix-exponential function, variation of constants, differential equations of nth order.

B. Partial differential equations:

- classification and well-posedness of 2nd order partial differential equations;
- wave equation, Poisson's equation, Fourier transform;
- solution methods: separation approach, Fourier transformation.

C. Numerical solution of differential equations:

- single step method (implicit/explicit);
- Runge-Kutta method;
- step size control.

Competencies / intended learning achievements

Folgende Kompetenzen sollen gefördert werden:

Fachkompetenz, Methodenkompetenz, Sozialkompetenz

Mit erfolgreichem Abschluss des Moduls werden die Studierenden in der Lage sein,

- die für ihr Fach spezifischen Techniken und Methoden der Vektoranalysis, die im weiteren Verlauf des Studiums benötigt

werden, sowie deren Anwendung bei Bedarf zu vertiefen, da sie sich Grundkenntnisse in Vektoranalysis, insbesondere im Bereich der Integration skalarer und vektorieller Funktionen über Flächen und Kurven, erarbeitet haben;

- die für ihr Fach spezifischen Konzepte und Methoden der gewöhnlichen und partiellen Differentialgleichungen, die im weiteren Verlauf des Studiums benötigt werden, sowie deren praktische Anwendung bei Bedarf zu vertiefen, da sie sich Grundkenntnisse zur Behandlung von gewöhnlichen und partiellen Differentialgleichungen erarbeitet haben;
- Probleme aus den Ingenieurwissenschaften zu modellieren und mittels obiger mathematischer Methoden zu bearbeiten und zu lösen, da sie dies exemplarisch gelernt und geübt haben.

In den Übungen haben sich die Studierenden einen sicheren und selbstständigen Umgang mit den Begriffen, Aussagen und Methoden aus der Vorlesung erarbeitet. Sie können in Beispielen die kennengelernten Methoden und Konzepte anwenden.

In den Übungen wurde außerdem die Präsentations- und Kommunikationsfähigkeit der Studierenden durch schriftliches Ausarbeiten von Lösungen und Präsentation in den Präsenzübungen geschult. Die Teamfähigkeit wurde durch Arbeit in Kleingruppen gefördert.

Registration

Registration for the exercise classes via the online administration system URM (<https://urm.mathematik.uni-kl.de>).

Requirements for attendance of the module (informal)

Modules:

- [MAT-00-01-M-1] Higher Mathematics I (M, 8.0 LP)
- [MAT-00-02-M-1] Higher Mathematics II (M, 8.0 LP)

Requirements for attendance of the module (formal)

None

References to Module / Module Number [MAT-00-03A-M-1]

Course of Study	Section	Choice/Obligation
[WIW-82.21-SG#2009] B.Sc. Business Studies (2009) [2009]	[Fundamentals] Integrative Courses	[WP] Compulsory Elective
[MV-82.103-SG] B.Sc. Mechanical Engineering	[Fundamentals] Mathematical and scientific fundamentals	[P] Compulsory
[WIW-82.175-SG#2009] B.Sc. Business Administration and Engineering specialising in Environmental and Process Engineering (2009) [2009]	[Fundamentals] Quantitative Methods	[P] Compulsory
[WIW-82.178-SG#2009] B.Sc. Business Administration and Engineering specialising in Electrical Engineering (2009) [2009]	[Fundamentals] Quantitative Methods	[P] Compulsory
[WIW-82.179-SG#2009] B.Sc. Business Administration and Engineering specialising in Mechanical Engineering (2009) [2009]	[Fundamentals] Quantitative Methods	[P] Compulsory
[EIT-82.781-SG#2019] B.Sc. Electrical and Computer Engineering [2019]	[Fundamentals] Fundamentals of Mathematics and Sciences (MNG)	[P] Compulsory
[WIW-82.789-SG#2009] B.Sc. Business Studies with Technical Qualifications (2009) [2009]	[Fundamentals] Integrative Courses	[WP] Compulsory Elective
[MV-82.814-SG] B.Sc. Mechanical Engineering with a minor in Economics	[Fundamentals] Mathematisch-naturwissenschaftliche Grundlagen	[P] Compulsory

[MV-82.B10-SG] B.Sc. Energy and Process Engineering	[Fundamentals] Mathematisch-naturwissenschaftliche Grundlagen	[P] Compulsory
[PHY-82.B90-SG] B.Sc. TechnoPhysics	[Fundamentals] Grundlagen der Höheren Mathematik	[P] Compulsory
[EIT-82.A44-SG#2021] B.Sc. Media and Communication Technology [2021]	[Fundamentals] Fundamentals of Mathematics and Sciences (MNG)	[P] Compulsory
[WIW-82.-SG#2021] B.Sc. Business Administration and Engineering specialising in Electrical Engineering (2021) [2021]	[Fundamentals] Scientific Basics and Methods	[P] Compulsory
[EIT-82.781-SG#2021] B.Sc. Electrical and Computer Engineering [2021]	[Fundamentals] Fundamentals of Mathematics and Sciences (MNG)	[P] Compulsory
[WIW-82.-SG#2021] B.Sc. Business Administration and Engineering specialising in Energy and Process Engineering (2021) [2021]	[Fundamentals] Scientific Basics and Methods	[P] Compulsory
[WIW-82.-SG#2021] B.Sc. Business Administration and Engineering specialising in Mechanical Engineering (2021) [2021]	[Fundamentals] Scientific Basics and Methods	[P] Compulsory
[MV-82.103b-SG#2022] B.Sc. Maschinenbau 2022 [2022]	[Fundamentals] Mathematical and scientific fundamentals	[P] Compulsory
[MV-82.-SG#2022] B.Sc. Energy and Process Engineering [2022]	[Fundamentals] Mathematisch-naturwissenschaftliche und programmiertechnische Grundlagen	[P] Compulsory
[MV-82.-SG#2022] B.Sc. Maschinenbau mit BWL 2022 [2022]	[Fundamentals] Mathematisch-naturwissenschaftliche und programmiertechnische Grundlagen	[P] Compulsory