



BRNO UNIVERSITY OF TECHNOLOGY



FACULTY OF MECHANICAL ENGINEERING
INSTITUTE OF MATHEMATICS

THESIS TITLE
CONTINUATION OF THE TITLE

DIPLOMA THESIS

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BRNO 2023

Abstract

A short summary of the thesis.

Keywords

keyword 1, keyword 2,...

I declare that I wrote the diploma thesis *Title* independently under the guidance of *supervisor's name* using the literature included in the list of references.

Author's name

Here, write a short thanks (to the supervisor, family, close person, etc.).

Author's name

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1 Introduction

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2 Section

2.1 Limit of a function

Definition 2.1 (limit of a function). We say that a function f has at a point $x_0 \in \mathbb{R}^*$ a *limit* $a \in \mathbb{R}^*$ (and we write $\lim_{x \rightarrow x_0} f(x) = a$) if, for any neighborhood $O(a)$, we can find a deleted neighborhood $O^*(x_0)$ such that, for each $x \in O^*(x_0)$, we have $f(x) \in O(a)$.

Remark. a) The definition covers four cases: if $x_0, a \in \mathbb{R} \dots$

b) Note that the definition uses a deleted neighborhood of x_0 , it does not contain any demand on $f(x_0)$.

Example 2.2. Show that $\lim_{x \rightarrow 0} f(x) = 0$ where $f(x) = \begin{cases} x^2 & \text{for } x \neq 0, \\ 1 & \text{for } x = 0. \end{cases}$

Solution. Let $\varepsilon > 0$ be arbitrary. Then $\forall x \in O_\delta^*(0)$, where $\delta = \sqrt{\varepsilon}$, it holds $|x^2 - 0| = x^2 < \delta^2 = \varepsilon$.

Theorem 2.3 (Heine¹ condition). A function f has a limit $a \in \mathbb{R}^*$ at the point $x_0 \in \mathbb{R}^* \Leftrightarrow$ for every sequence $\{x_n\}_{n=1}^\infty \subseteq D(f)$ such that $\lim_{n \rightarrow \infty} x_n = x_0$, $x_n \neq x_0 \forall n \in \mathbb{N}$, we have $\lim_{n \rightarrow \infty} f(x_n) = a$.

Proof. “ \Rightarrow ” Let $\lim_{x \rightarrow x_0} f(x) = a \in \mathbb{R}^*$ and $\{x_n\}$ be a sequence...

“ \Leftarrow ” Assume...

□

Basic limits

1. Let $f(x) = c \in \mathbb{R}$ for each $x \in \mathbb{R}$. Then, for any $x_0 \in \mathbb{R}^*$, we have $\lim_{x \rightarrow x_0} f(x) = c$.
2. Let P be a polynomial. Then, for arbitrary $x_0 \in \mathbb{R}$, we have $\lim_{x \rightarrow x_0} P(x) = P(x_0)$.
3. ...

¹Heinrich Eduard Heine 1821–1881, German

Tables

Tables should have captions (the command `\caption`) above. At the end of the caption (of both tables or figures) we do not write a dot. One of the typographical rules says that we should avoid vertical lines.

Table 2.1: Laplace transform of selected functions

$f(x), x \geq 0$	$\mathcal{L}\{f\}(s)$	$f(x), x \geq 0$	$\mathcal{L}\{f\}(s)$
1	$\frac{1}{s}, \operatorname{Re} s > 0$	$\sin ax$	$\frac{a}{s^2 + a^2}, \operatorname{Re} s > 0$
x	$\frac{1}{s^2}, \operatorname{Re} s > 0$	$\cos ax$	$\frac{s}{s^2 + a^2}, \operatorname{Re} s > 0$
$x^n,$	$\frac{n!}{s^{n+1}}, \operatorname{Re} s > 0$	$e^{ax} \sin bx$	$\frac{b}{(s-a)^2 + b^2}, \operatorname{Re} s > a$
$e^{ax},$	$\frac{1}{s-a}, \operatorname{Re} s > a$	$e^{ax} \cos bx$	$\frac{s-a}{(s-a)^2 + b^2}, \operatorname{Re} s > a$
$xe^{ax},$	$\frac{1}{(s-a)^2}, \operatorname{Re} s > a$	$x \sin ax$	$\frac{2as}{(s^2 + a^2)^2}, \operatorname{Re} s > 0$
$x^n e^{ax},$	$\frac{n!}{(s-a)^{n+1}}, \operatorname{Re} s > a$	$x \cos ax$	$\frac{s^2 - a^2}{(s^2 + a^2)^2}, \operatorname{Re} s > 0$

Figures

Captions of figures (again the command `\caption`) should be placed below the figure, see Fig. 2.1. The preference is to create a vector graphics (optimally in PDF format), e.g., as export from Matlab/Maple software in combination with consequent editing in IPE graphical editor (or similar).



Figure 2.1: FSI logo

For typesetting mathematical environments, it is recommended to use the package “amsmath” (it includes `align`, `alignat`, `gather`, `multline` environments):

$$a^2 + b^2 = c^2. \quad (\text{Do not forget a dot behind the formula.}) \quad (2.1)$$

It follows from (2.1)...

$$\lim_{n \rightarrow \infty} \frac{a_k n^k + a_{k-1} n^{k-1} + \dots + a_1 n + a_0}{b_\ell n^\ell + b_{\ell-1} n^{\ell-1} + \dots + b_1 n + b_0} = \begin{cases} 0 & \text{je-li } k < \ell, \\ a_k/b_\ell & \text{je-li } k = \ell, \\ \pm\infty & \text{je-li } k > \ell \end{cases} \quad (\text{improper limit, will be specified later}).$$

The list of references can be created using via the portal “Citace PRO” (<https://www.citacepro.com/vut>), unfortunately, it offers the formats that are not so common in the mathematical disciplines. Citations of the particular references’ items are carried out with help of the command `\cite{name-in-bibitem}`, see examples below.

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- [1] Čermák, J., Nechvátal, L., *On a problem of linearized stability for fractional difference equations*, Nonlinear Dyn. **104** (2021), 1253–1267.
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