

Lecture Notes in Mathematics

Edited by J.-M. Morel, F. Takens and B. Teissier

Editorial Policy

for the publication of monographs

1. Lecture Notes aim to report new developments in all areas of mathematics – quickly, informally and at a high level. Monograph manuscripts should be reasonably self-contained and rounded off. Thus they may, and often will, present not only results of the author but also related work by other people. They may be based on specialized lecture courses. Furthermore, the manuscripts should provide sufficient motivation, examples and applications. This clearly distinguishes Lecture Notes from journal articles or technical reports which normally are very concise. Articles intended for a journal but too long to be accepted by most journals, usually do not have this “lecture notes” character. For similar reasons it is unusual for doctoral theses to be accepted for the Lecture Notes series.

2. Manuscripts should be submitted (preferably in duplicate) either to one of the series editors or to Springer-Verlag, Heidelberg. In general, manuscripts will be sent out to 2 external referees for evaluation. If a decision cannot yet be reached on the basis of the first 2 reports, further referees may be contacted: the author will be informed of this. A final decision to publish can be made only on the basis of the complete manuscript, however a refereeing process leading to a preliminary decision can be based on a pre-final or incomplete manuscript. The strict minimum amount of material that will be considered should include a detailed outline describing the planned contents of each chapter, a bibliography and several sample chapters.

Authors should be aware that incomplete or insufficiently close to final manuscripts almost always result in longer refereeing times and nevertheless unclear referees’ recommendations, making further refereeing of a final draft necessary.

Authors should also be aware that parallel submission of their manuscript to another publisher while under consideration for LNM will in general lead to immediate rejection.

3. Manuscripts should in general be submitted in English.

Final manuscripts should contain at least 100 pages of mathematical text and should include

- a table of contents;
- an informative introduction, with adequate motivation and perhaps some historical remarks: it should be accessible to a reader not intimately familiar with the topic treated;
- a subject index: as a rule this is genuinely helpful for the reader.

Continued on inside back-cover

Lecture Notes in Mathematics

1791

Editors:

J.-M. Morel, Cachan

F. Takens, Groningen

B. Teissier, Paris

Springer

Berlin

Heidelberg

New York

Barcelona

Hong Kong

London

Milan

Paris

Tokyo

Manfred Knebusch
Digen Zhang

Manis Valuations and Prüfer Extensions I

A New Chapter in Commutative Algebra



Springer

Authors

Manfred Knebusch
Digen ZHANG
Department of Mathematics
University of Regensburg
Universitätstr. 31
93040 Regensburg
Germany

e-mail:

Manfred.Knebusch@mathematik.uni-regensburg.de
Digen.Zhang@mathematik.uni-regensburg.de

Cover: "A good mathematician needs no counting rod",
Lao Tse in Dao De Jing, chapter 27

Cataloging-in-Publication Data applied for.

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Knebusch, Manfred:
Manis valuations and Prüfer extensions / Manfred Knebusch ; Digen Zhang. -
Berlin ; Heidelberg ; New York ; Barcelona ; Hong Kong ; London ; Milan ;
Paris ; Tokyo : Springer
1. A new chapter in commutative algebra. - 2002
(Lecture notes in mathematics ; 1791)
ISBN 3-540-43951-X

Mathematics Subject Classification (2000):

PRIMARY 13A15, 13A18, 13F05, SECONDARY 13B02, 14A05, 14P10, 14P05

ISSN 0075-8434

ISBN 3-540-43951-x Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

Springer-Verlag Berlin Heidelberg New York a member of BertelsmannSpringer
Science + Business Media GmbH

<http://www.springer.de>

© Springer-Verlag Berlin Heidelberg 2002
Printed in Germany

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: Camera-ready TeX output by the author

SPIN: 10884676 41/3142/ du - 543210 - Printed on acid-free paper

Contents

Introduction	1
Summary	7
Chapter I: Basics on Manis valuations and Prüfer extensions	9
§1 Valuations on rings	10
§2 Valuation subrings and Manis pairs	22
§3 Weakly surjective homomorphisms	32
§4 More on weakly surjective extensions	41
§5 Basic theory of Prüfer extensions	46
§6 Examples of Prüfer extensions and convenient ring extensions	57
§7 Principal ideal results	73
Chapter II: Multiplicative ideal theory	83
§1 Multiplicative properties of regular modules	84
§2 Characterizing Prüfer extensions by the behavior of their regular ideals	93
§3 Describing a Prüfer extension by its lattice of regular ideals	105
§4 Tight extensions	109
§5 Distributive submodules	119
§6 Transfer theorems	123
§7 Polars and factors in a Prüfer extension	129
§8 Decomposition of regular modules	134
§9 Prüfer overmodules	140
§10 Bezout extensions	144
§11 The Prüfer extensions of a noetherian ring	159
§12 Invertible hulls for modules over noetherian rings	169

Chapter III: PM-valuations and valuations of weaker type	177
§1 The PM-overrings in a Prüfer extension	178
§2 Regular modules in a PM-extension	182
§3 More ways to characterize PM-extensions, and a look at BM-extensions	186
§4 Tight valuations	198
§5 Existence of various valuation hulls	205
§6 Inside and outside the Manis valuation hull	214
§7 The TV-hull in a valuative extension	222
§8 Principal valuations	228
§9 Descriptions of the PM-hull	233
§10 Composing valuations with ring homomorphisms	240
§11 Transfer of valuations	243
Appendix	251
Appendix A (to I, §4 and I, §5): Flat epimorphisms	251
Appendix B (to II, §2): Arithmetical rings	252
Appendix C (to III, §6): A direct proof of the existence of Manis valuation hulls	255
References	257
Index	263
Subject Index	263
Symbol Index	266