

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

LONDON MATHEMATICAL SOCIETY LECTURE NOTE SERIES

Managing Editor: Professor I.M. James,
Mathematical Institute, 24-29 St Giles, Oxford

1. General cohomology theory and K-theory, P.HILTON
4. Algebraic topology, J.F.ADAMS
5. Commutative algebra, J.T.KNIGHT
8. Integration and harmonic analysis on compact groups, R.E.EDWARDS
9. Elliptic functions and elliptic curves, P.DU VAL
10. Numerical ranges II, F.F.BONSALL & J.DUNCAN
11. New developments in topology, G.SEGAL (ed.)
12. Symposium on complex analysis, Canterbury, 1973, J.CLUNIE & W.K.HAYMAN (eds.)
13. Combinatorics: Proceedings of the British Combinatorial Conference 1973, T.P.McDONOUGH & V.C.MAVRON (eds.)
15. An introduction to topological groups, P.J.HIGGINS
16. Topics in finite groups, T.M.GAGEN
17. Differential germs and catastrophes, Th.BROCKER & L.LANDER
18. A geometric approach to homology theory, S.BUONCRISTIANO, C.P. BOURKE & B.J.SANDERSON
20. Sheaf theory, B.R.TENNISON
21. Automatic continuity of linear operators, A.M.SINCLAIR
23. Parallelisms of complete designs, P.J.CAMERON
24. The topology of Stiefel manifolds, I.M.JAMES
25. Lie groups and compact groups, J.F.PRICE
26. Transformation groups: Proceedings of the conference in the University of Newcastle-upon-Tyne, August 1976, C.KOSNIOWSKI
27. Skew field constructions, P.M.COHN
28. Brownian motion, Hardy spaces and bounded mean oscillations, K.E.PETERSEN
29. Pontryagin duality and the structure of locally compact Abelian groups, S.A.MORRIS
30. Interaction models, N.L.BIGGS
31. Continuous crossed products and type III von Neumann algebras, A.VAN DAELE
32. Uniform algebras and Jensen measures, T.W.GAMELIN
33. Permutation groups and combinatorial structures, N.L.BIGGS & A.T.WHITE
34. Representation theory of Lie groups, M.F. ATIYAH et al.
35. Trace ideals and their applications, B.SIMON
36. Homological group theory, C.T.C.WALL (ed.)
37. Partially ordered rings and semi-algebraic geometry, G.W.BRUMFIEL
38. Surveys in combinatorics, B.BOLLOBAS (ed.)
39. Affine sets and affine groups, D.G.NORTHCOTT
40. Introduction to Hp spaces, P.J.KOOSIS
41. Theory and applications of Hopf bifurcation, B.D.HASSARD, N.D.KAZARINOFF & Y-H.WAN
42. Topics in the theory of group presentations, D.L.JOHNSON
43. Graphs, codes and designs, P.J.CAMERON & J.H.VAN LINT
44. $\mathbb{Z}/2$ -homotopy theory, M.C.CRABB
45. Recursion theory: its generalisations and applications, F.R.DRAKE & S.S.WAINER (eds.)
46. p-adic analysis: a short course on recent work, N.KOBLITZ
47. Coding the Universe, A.BELLER, R.JENSEN & P.WELCH
48. Low-dimensional topology, R.BROWN & T.L.THICKSTUN (eds.)

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

49. Finite geometries and designs, P.CAMERON, J.W.P.HIRSCHFELD & D.R.HUGHES (eds.)
50. Commutator calculus and groups of homotopy classes, H.J.BAUES
51. Synthetic differential geometry, A.KOCK
52. Combinatorics, H.N.V.TEMPERLEY (ed.)
53. Singularity theory, V.I.ARNOLD
54. Markov processes and related problems of analysis, E.B.DYNKIN
55. Ordered permutation groups, A.M.W.GLASS
56. Journées arithmétiques 1980, J.V.ARMITAGE (ed.)
57. Techniques of geometric topology, R.A.FENN
58. Singularities of smooth functions and maps, J.MARTINET
59. Applicable differential geometry, F.A.E.PIRANI & M.CRAMPIN
60. Integrable systems, S.P.NOVIKOV et al.
61. The core model, A.DODD
62. Economics for mathematicians, J.W.S.CASELS
63. Continuous semigroups in Banach algebras, A.M.SINCLAIR
64. Basic concepts of enriched category theory, G.M.KELLY
65. Several complex variables and complex manifolds I, M.J.FIELD
66. Several complex variables and complex manifolds II, M.J.FIELD
67. Classification problems in ergodic theory, W.PARRY & S.TUNCEL
68. Complex algebraic surfaces, A.BEAUVILLE
69. Representation theory, I.M.GELFAND et. al.
70. Stochastic differential equations on manifolds, K.D.ELWORTHY
71. Groups - St Andrews 1981, C.M.CAMPBELL & E.F.ROBERTSON (eds.)
72. Commutative algebra: Durham 1981, R.Y.SHARP (ed.)
73. Riemann surfaces: a view toward several complex variables, A.T.HUCKLEBERRY
74. Symmetric designs: an algebraic approach, E.S.LANDER

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

London Mathematical Society Lecture Note Series. 72

Commutative Algebra: Durham 1981

Edited by

R.Y. SHARP

Reader in Pure Mathematics

University of Sheffield

CAMBRIDGE UNIVERSITY PRESS

Cambridge

London New York New Rochelle

Melbourne Sydney

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore,
São Paulo, Delhi, Dubai, Tokyo, Mexico City

Cambridge University Press

The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9780521271257

© Cambridge University Press 1982

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without the written
permission of Cambridge University Press.

First published 1982

Re-issued 2010

A catalogue record for this publication is available from the British Library

Library of Congress Catalogue Card Number: 82-12781

ISBN 978-0-521-27125-7 Paperback

Cambridge University Press has no responsibility for the persistence or
accuracy of URLs for external or third-party internet websites referred to in
this publication, and does not guarantee that any content on such websites is,
or will remain, accurate or appropriate.

CONTENTS

Preface	vii
Addresses of contributors	ix
List of participants	xi
PART I: THE LOCAL HOMOLOGICAL CONJECTURES, BIG COHEN-MACAULAY MODULES, AND RELATED TOPICS	
The syzygy problem: a new proof and historical perspective E.G. EVANS and PHILLIP GRIFFITH	2
The theory of homological dimensions of complexes HANS-BJØRN FOXBY	12
Complexes of injective modules HANS-BJØRN FOXBY	18
The local homological conjectures MELVIN HOCHSTER	32
The rank of a module G. HORROCKS	55
Modules of generalized fractions and balanced big Cohen-Macaulay modules R.Y. SHARP and H. ZAKERI	61
Sur la théorie des complexes parfaits L. SZPIRO	83
PART II: DETERMINANTAL IDEALS, FINITE FREE RESOLUTIONS, AND RELATED TOPICS	
Some exact complexes and filtrations related to certain special Young diagrams KAAN AKIN and DAVID A. BUCHSBAUM	92
The canonical module of a determinantal ring WINFRIED BRUNS	109
The MacRae invariant HANS-BJØRN FOXBY	121
Finite free resolutions and some basic concepts of commutative algebra D.G. NORTHCOTT	129

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

vi

PART III: MULTIPLICITY THEORY, HILBERT AND POINCARÉ SERIES, ASSOCIATED GRADED RINGS, AND RELATED TOPICS	
Blowing-up of Buchsbaum rings SHIRO GOTO	140
Necessary conditions for an analytical algebra to be strict J. HERZOG	163
Multiplicities, Hilbert functions and degree functions D. REES	170
Finiteness conditions in commutative algebra and solution of a problem of Vasconcelos JAN-ERIK ROOS	179
On the use of graded Lie algebras in the theory of local rings JAN-ERIK ROOS	204
Reductions, local cohomology and Hilbert functions of local rings JUDITH D. SALLY	231
FURTHER PROBLEMS	243

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

PREFACE

A Symposium on Commutative Algebra was held at the University of Durham during the period 15-25 July, 1981, under the auspices of the London Mathematical Society and with financial support from the Science and Engineering Research Council. There were 71 participants.

The academic programme was built round a series of invited one hour lectures; in addition, many participants volunteered lectures at sessions of short talks. It was decided, on account of limitations of space, to restrict this volume to articles by the invited speakers related to lectures given at the Symposium, although all participants were welcome to contribute to the section of 'Further problems' at the end of the book. The articles have been grouped together in sections in the hope that the result will reflect the flavour of the main themes of the Symposium. The first group of papers is concerned with the local homological conjectures, big Cohen-Macaulay modules, and related topics and applications; the second group consists of articles related to determinantal ideals and finite free resolutions; and the third group is concerned with various topics in local algebra, including multiplicity theory, Hilbert and Poincaré series, and associated graded rings. Within each section, the papers are arranged in alphabetical order of authors' names.

Participants at the Symposium were invited to submit open problems in commutative algebra for inclusion in a Problem Section in these proceedings, and the response to that invitation is contained in the final section of the book, entitled 'Further problems'. I am grateful to the contributors for their efforts.

I am also very grateful to Mrs. Elsie Benson and Mrs. Janet

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

viii

Williams for their beautiful typing of the camera-ready copy for this book.

It is a pleasure to record my gratitude, and that of my co-organizer, D.G. Northcott, to the numerous members of staff of Durham and Sheffield Universities who contributed so much to the smooth-running arrangements and friendly atmosphere of the Symposium: we are particularly grateful to Dr. L.M. Woodward of the Durham University Mathematics Department, Mrs. M.O. Lund of the Durham University Finance Department, Captain G.R.T. Duffay, the Bursar of Grey College, and our Sheffield colleagues Drs. T.B. Cruddis, A.J. Douglas and D.W. Sharpe.

Finally, we should like to record our gratitude to the London Mathematical Society, under whose auspices the Symposium took place and this book will appear, and the Science and Engineering Research Council, without whose financial support the Symposium could not have taken place.

R.Y. Sharp

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

ADDRESSES OF CONTRIBUTORS

- KAAN AKIN and DAVID A. BUCHSBAUM, Department of Mathematics,
Brandeis University, Waltham, Mass. 02154, U.S.A.
- WINFRIED BRUNS, Fachbereich 3, Naturwissenschaften, Mathematik,
Universität Osnabrück-Abteilung Vechta-Driverstrasse 22,
D-2848 Vechta, West Germany.
- E.G. EVANS and PHILLIP GRIFFITH, Department of Mathematics,
University of Illinois, Urbana, Illinois 61801, U.S.A.
- HANS-BJØRN FOXBY, Matematisk Institut, Københavns Universitet,
Universitetsparken 5, DK 2100 København Ø, Denmark.
- SHIRO GOTO, Department of Mathematics, Nihon University,
Sakurajosui 3-25-40, Setagaya-ku, Tokyo, Japan.
- J. HERZOG, Universität Essen-Gesamthochschule, Fachbereich
6-Mathematik, Universitätsstrasse 3, Postfach 103764, D-4300
Essen 1, West Germany.
- MELVIN HOCHSTER, Department of Mathematics, University of Michigan,
Ann Arbor, Michigan 48109, U.S.A.
- G. HORROCKS, School of Mathematics, University of Newcastle upon Tyne,
Newcastle upon Tyne NE1 7RU, U.K.
- D.G. NORTHCOTT, Department of Pure Mathematics, University of
Sheffield, Hicks Building, Sheffield S3 7RH, U.K.
- D. REES, Department of Mathematics, University of Exeter, North Park
Road, Exeter EX4 4QE, U.K.
- JAN-ERIK ROOS, Department of Mathematics, University of Stockholm,
Box 6701, S-113 85 Stockholm, Sweden.
- JUDITH D. SALLY, Department of Mathematics, Northwestern University,
Evanston, Illinois 60201, U.S.A.
- R.Y. SHARP and H. ZAKERI, Department of Pure Mathematics, University
of Sheffield, Hicks Building, Sheffield S3 7RH, U.K.
- L. SZPIRO, École Normale Supérieure, 45, Rue d'Ulm, 75230 Paris
Cedex 05, France.

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

LIST OF PARTICIPANTS

Barnard, A.D.	(King's, London)	Macdonald, I.G.	(Q.M.C., London)
Bartijn, J.	(Utrecht)	McLean, K.R.	(Liverpool)
Bijan-Zadeh, M.H.	(Tehran)	MacRae, R.E.	(Boulder)
Bjögvað, R.	(Stockholm)	Massaza, C.	(Siena)
Boratyński, M.	(Warsaw)	Merriman, J.R.	(Canterbury)
Brodmann, M.	(Zürich)	Moore, D.J.	(Glasgow)
Brown, M.L.	(Coventry)	Nastold, H.-J.	(Münster)
Bruns, W.	(Osnabrück/Vechta)	Northcott, D.G.	(Sheffield)
Buchsbaum, D.A.	(Brandeis)	O'Carroll, L.	(Edinburgh)
Chatters, A.W.	(Bristol)	Orbanz, U.	(Köln)
Cruddis, T.B.	(Sheffield)	Orecchia, F.	(Napoli)
Douglas, A.J.	(Sheffield)	Porter, T.	(Bangor)
Evans, E.G.	(Urbana)	Pragacz, P.	(Toruń)
Faltings, G.	(Münster)	Qureshi, M.A.	(Edinburgh)
Flenner, H.	(Osnabrück)	Ragusa, A.	(Catania)
Foxby, H.-B.	(Norman, Oklahoma)	Ratliff, L.J.	(Riverside)
Fröberg, R.	(Stockholm)	Rayner, F.J.	(Liverpool)
Gotô, S.	(Tokyo)	Rees, D.	(Exeter)
Greco, S.	(Torino)	Rhodes, C.P.L.	(Cardiff)
Hajarnavis, C.R.	(Warwick)	Riley, A.M.	(Sheffield)
Herzog, J.	(Essen)	Robbiano, L.	(Genova)
Hochster, M.	(Ann Arbor)	Roberts, P.C.	(Salt Lake City)
Horrocks, G.	(Newcastle)	Roos, J.-E.	(Stockholm)
Huneke, C.	(Ann Arbor)	Rotthaus, C.	(Münster)
Józefiak, T.	(Toruń)	Sally, J.D.	(Evanston)
Kirby, D.	(Southampton)	Schenzel, P.	(Halle)
Lascoux, A.	(Paris)	Sharp, R.Y.	(Sheffield)
Lech, C.	(Stockholm)	Sharpe, D.W.	(Sheffield)

Cambridge University Press

978-0-521-27125-7 - Commutative Algebra: Durham 1981

Edited by R. Y. Sharp

Frontmatter

[More information](#)

xii

Shimoda, Y.	(Tokyo)	Vasconcelos, W.V.	(New Brunswick)
Simis, A.	(Rio de Janeiro)	Vetter, U.	(Osnabrück/Vechta)
Stafford, J.T.	(Cambridge)	Weyman, J.	(Toruń)
Strano, R.	(Catania)	Wilson, P.M.H.	(Cambridge)
Strooker, J.R.	(Utrecht)	Wiseman, A.N.	(Sheffield)
Szpiro, L.	(Paris)	Woodcock, C.F.	(Canterbury)
Valla, G.	(Genova)	Zakeri, H.	(Sheffield)
Vámos, P.	(Sheffield)	71	