

CONTENTS

<i>Preface</i>	<i>page ix</i>
1. Generalities concerning modules	
1.1 Left modules and right modules	1
1.2 Submodules	3
1.3 Factor modules	3
1.4 Λ -homomorphisms	3
1.5 Some different types of Λ -homomorphisms	4
1.6 Induced mappings	5
1.7 Images and kernels	6
1.8 Modules generated by subsets	7
1.9 Direct products and direct sums	9
1.10 Abbreviated notations	12
1.11 Sequences of Λ -homomorphisms	13
2. Tensor products and groups of homomorphisms	
2.1 The definition of tensor products	16
2.2 Tensor products over commutative rings	17
2.3 Continuation of the general discussion	18
2.4 Tensor products of homomorphisms	19
2.5 The principal properties of $\text{Hom}_\Lambda(B, C)$	24
3. Categories and functors	
3.1 Abstract mappings	30
3.2 Categories	31
3.3 Additive and Λ -categories	32

3.4	Equivalences	<i>page</i> 32
3.5	The categories \mathcal{G}_Λ^L and \mathcal{G}_Λ^R	33
3.6	Functors of a single variable	33
3.7	Functors of several variables	34
3.8	Natural transformations of functors	35
3.9	Functors of modules	36
3.10	Exact functors	38
3.11	Left exact and right exact functors	40
3.12	Properties of right exact functors	41
3.13	$A \otimes_\Lambda C$ and $\text{Hom}_\Lambda(B, C)$ as functors	44
4.	Homology functors	
4.1	Diagrams over a ring	46
4.2	Translations of diagrams	47
4.3	Images and kernels as functors	48
4.4	Homology functors	52
4.5	The connecting homomorphism	54
4.6	Complexes	59
4.7	Homotopic translations	62
5.	Projective and injective modules	
5.1	Projective modules	63
5.2	Injective modules	67
5.3	An existence theorem for injective modules	71
5.4	Complexes over a module	75
5.5	Properties of resolutions of modules	77
5.6	Properties of resolutions of sequences	80
5.7	Further results on resolutions of sequences	84

6. Derived functors

6.1	Functors of complexes	<i>page</i> 90
6.2	Functors of two complexes	94
6.3	Right-derived functors	99
6.4	Left-derived functors	109
6.5	Connected sequences of functors	113

7. Torsion and extension functors

7.1	Torsion functors	121
7.2	Basic properties of torsion functors	123
7.3	Extension functors	128
7.4	Basic properties of extension functors	130
7.5	The homological dimension of a module	134
7.6	Global dimension	138
7.7	Noetherian rings	144
7.8	Commutative Noetherian rings	148
7.9	Global dimension of Noetherian rings	149

8. Some useful identities

8.1	Bimodules	155
8.2	General principles	156
8.3	The associative law for tensor products	160
8.4	Tensor products over commutative rings	161
8.5	Mixed identities	164
8.6	Rings and modules of fractions	167

9. Commutative Noetherian rings of finite global dimension

9.1	Some special cases	174
9.2	Reduction of the general problem	184
9.3	Modules over local rings	189

9.4	Some auxiliary results	<i>page</i> 202
9.5	Homological codimension	204
9.6	Modules of finite homological dimension	205
10.	Homology and cohomology theories of groups and monoids	
10.1	General remarks concerning monoids and groups	211
10.2	Modules with respect to monoids and groups	214
10.3	Monoid-rings and group-rings	215
10.4	The functors A^G and A_G	217
10.5	Axioms for the homology theory of monoids	219
10.6	Axioms for the cohomology theory of monoids	221
10.7	Standard resolutions of Z	223
10.8	The first homology group	229
10.9	The first cohomology group	230
10.10	The second cohomology group	238
10.11	Homology and cohomology in special cases	244
10.12	Finite groups	249
10.13	The norm of a homomorphism	252
10.14	Properties of the complete derived sequence	256
10.15	Complete free resolutions of Z	259
	<i>Notes</i>	266
	<i>References</i>	278
	<i>Index</i>	281