

References

- [EGA] A. GROTHENDIECK, with J. DIEUDONNÉ, *Éléments de géométrie algébrique*, Publ. Math. I.H.E.S. **4**, **8**, **11**, **17**, **20**, **24**, **28**, **32** (1961–1967)
- [SGA 6] P. BERTHELOT, A. GROTHENDIECK, L. ILLUSIE, *et al.*, *Théorie des intersections et théorème de Riemann-Roch*, Springer Lecture Notes 225, 1971
- [AK] A. ALTMAN, S. KLEIMAN, *Introduction to Grothendieck duality theory*, Springer Lecture Notes 146, 1970
- [At] M. ATIYAH, *K-Theory*, Benjamin, 1967
- [At-Hi] M. ATIYAH and F. HIRZEBRUCH, *Cohomologie-Operationen und charakteristische Klassen*, Math. Z. **77** (1961) pp. 149–187
- [AT] M. F. ATIYAH, D. O. TALL, *Group representations, λ -rings and the J-homomorphism*, Topology **8** (1969) pp. 253–297
- [BFM 1] P. BAUM, W. FULTON, R. MACPHERSON, *Riemann–Roch for singular varieties*, Publ. Math. I.H.E.S. **45** (1975) pp. 101–145
- [BFM 2] ———, *Riemann–Roch and topological K-theory for singular varieties*, Acta. Math. **143** (1979) pp. 155–192
- [BFQ] P. BAUM, W. FULTON, G. QUART, *Lefschetz–Riemann–Roch for singular varieties*, Acta. Math. **143** (1979) pp. 193–211
- [BS] A. BOREL, J.-P. SERRE, *Le théorème de Riemann–Roch (d’après Grothendieck)*, Bull. Soc. Math. France **86** (1958) pp. 97–136
- [B] M. BORELLI, *Some results on ampleness and divisorial schemes*, Pacific J. Math. **23** (1967) pp. 217–227
- [Bo] R. BOTT, *Lectures on $K(X)$* , Benjamin, 1969
- [Ev] L. EVENS, *On the Chern classes of representations of finite groups*, Trans. Amer. Math. Soc. **115** (1965) pp. 180–193
- [Ev-K] L. EVENS and D. S. KAHN, *An integral Riemann–Roch formula for induced representations for finite groups*, Trans. Am. Math. Soc. **245** (1978) pp. 809–330
- [F 1] W. FULTON, *A fixed point formula for varieties over finite fields*, Math. Scand. **42** (1978) pp. 189–196
- [F 2] W. FULTON, *Intersection Theory*, Springer-Verlag, 1984

- [FM] W. FULTON, R. MACPHERSON, *Categorical framework for the study of singular spaces*, Mem. Amer. Math. Soc. **243**, 1981
- [Gr] A. GROTHENDIECK, *Classes de Chern et représentations linéaires des groupes discrets*, Dix exposés sur la cohomologie étale des schemas, North-Holland, Amsterdam, 1968
- [H] R. HARTSHORNE, *Algebraic geometry*, Springer-Verlag, 1977
- [Hi] F. HIRZEBRUCH, *Neue topologische Methoden in der algebraischen Geometrie*, Ergebnisse der Mathematik, Springer-Verlag, 1956; Translated and expanded to the English edition, *Topological Methods in Algebraic Geometry*, Grundlehren der Mathematik, Springer-Verlag, 1966
- [J] J. P. JOUANOLOU, *Riemann-Roch sans dénominateurs*, Inv. Math. **11**, (1970) pp. 15–26
- [Ke] M. KERVAIRE, *Opérations d'Adams en théorie des représentations linéaires des groupes finis*, l'Ens. Math. **22** (1976) pp. 1–28
- [Kn] J. KNOPFMACHER, *Chern classes of representations of finite groups*, J. London Math. Soc. **41** (1965) pp. 535–541
- [Kn] D. KNUTSON, *λ -rings and the representation theory of the symmetric group*, Springer Lecture Notes 308, 1973
- [Kr] Ch. KRATZER, *Opérations d'Adams et représentations de groupes*, l'Ens. Math. **26** (1980) pp. 141–154
- [L] S. LANG, *Algebra*, second edition, Addison-Wesley, 1984
- [Man] Y. I. MANIN, *Lectures on the K-functor in algebraic geometry*, Russ. Math. Surveys **24**, No. 5 (1969) pp. 1–89
- [Mat] H. MATSUMURA, *Commutative algebra*, second edition, Benjamin/Cummings, 1980
- [Mi] A. MICALI, *Sur les algèbres universelles*, Ann. Inst. Fourier, Grenoble **14** (1964) pp. 33–88
- [Q] D. QUILLEN, *Higher algebraic K-theory: I*, Springer Lecture Notes 341, 1973 pp. 85–147
- [S] C. SOULÉ, *Opérations en K-théorie algébrique*, CNRS preprint, 1983
- [Th 1] C. B. THOMAS, *Riemann–Roch formulae for group representations*, Mathematika **20** (1973) pp. 253–262
- [Th 2] C. B. THOMAS, *An integral Riemann–Roch formula for flat line bundles*, Proc. London Math. Soc. **XXXIV** (1977) pp. 87–101
- [V] J.-L. VERDIER, *Le théorème de Riemann–Roch pour les intersections complètes*, Astérisque **36–37** (1976) pp. 189–228

Index of Notations

A	the other ring in Riemann–Roch, 11, 28
A_c	extension of A determined by c , 15
$A(X)$	receives values of Chern character, 17, 28
$\text{Bl}_X(Y)$	blow up of X in Y , 91
c, c_i	Chern class and power series, 12, 54
ch	Chern character, 17, 125
ch_φ	Chern character associated with power series φ , 17
\mathcal{C}	conormal sheaf, 77
γ^i, γ_i	Grothendieck operations and power series, 47
e^\vee	involution of e , 20
\mathbf{E}	positive elements in K , 3
\mathbf{E}_e	positive elements in extension K_e , 9
ε	augmentation, 3
f^A, f_A	homomorphisms induced by f in A , 28
f^K, f_K	homomorphisms induced by f in K , 28
f^G, f_G	homomorphisms induced by f in G , 28, 144
F^n	Grothendieck γ -filtration, 48
F_m	lower filtration, 178
F_{top}^n	topological filtration, 120
f_e	canonical functional from K_e to K , 10
G	in practice, $\text{Gr } K$ or $\text{QGr } K$, 61
g_c	canonical functional from A_c to A , 15
Gr^i	Grothendieck graded component, 54
$\text{Gr}(K)$	Grothendieck associated graded ring, 54
K	λ -ring and K -functor, 3
K_e	extension of K determined by e , 7
$K(X)$	Grothendieck group of X , 102
$K(a)$	Koszul complex, 70, 106
$K, K.$	upper and lower K -groups, 164
$\ell,$	canonical generator of K_e , 8, 15
\mathbf{L}	line elements in K , 4, 53
λ	as in λ -ring, 3
λ^i	lambda operations, 3
λ_i	lambda power series, 3

p_c	polynomial equation defining A_c , 15
p_e	polynomial equation defining K_e , 7
$\mathbf{P}(\mathcal{E})$	Projective bundle $\text{Proj Sym}(\mathcal{E})$, 67
$P_k, P_{k,j}$	certain universal polynomials, 9
$\text{Pic}(X)$	isomorphism classes of invertible sheaves, 103
\mathcal{O}	universal hyperplane bundle, 67
$R^i f_*$	higher direct images, 105
$\mathfrak{R}_{\mathbf{P}}$	Regular sheaves, 107
ψ, ψ_t	Adams operations, 23
\mathfrak{S}_X	coherent sheaves on X having finite locally free resolutions, 126
σ^i, σ_t	related to the classes of Sym^i , 7, 117
$\mathcal{F}_n(\mathcal{F})$	canonical sheaves in canonical resolution of \mathcal{F} , 113
T_f	tangent element, 144
τ_f	Riemann–Roch multiplier, 28
td	Todd homomorphism, 19
$\text{td}_{\varphi,t}$	Todd power series, 20
θ^j	Adams multiplier, 24
$V(m)$	m -th eigenspace for Adams operations, 60
$\mathbf{V}(\mathcal{E})$	vector bundle of \mathcal{E} , 68
\mathfrak{B}_X	category of locally free sheaves on X , 102
x^\vee	involution of x , 20

Index

A

- Adams character 23, 60
- Adams multiplier 24
- Adams operations 23, 58
- Adams Riemann–Roch 37, 63, 119, 142, 146, 149, 190
- Ample 52, 118
- Associated functional 10, 15, 117
- Associated Hirzebruch polynomial 17, 19
- Augmentation 3
- Augmented Koszul complex 71

B

- Basic deformation 30, 142, 144, 160
- Blow up 91, 97, 169, 172, 177
- Blow up diagram 91, 172
- Blow up formula 155, 156
- Bott's cannibalistic classes 24

C

- Canonical generator 8, 15, 115
- Canonical positive structure 9
- Canonical resolution 113
- Canonical section 77
- Cap product 180
- Chern character 17, 125
- Chern class 12, 54
- Chern class functor 31, 142, 144, 146
- Chern class homomorphism 12
- Chern polynomial 13
- Chern root 14
- Chevalley–Warning formula 196
- Codimension 86, 89, 120
- Complex 119
- Conormal sheaf 77, 153
- Contravariance for lower K 184
- Cotangent sheaf 81
- Covariance 28, 37, 116, 127, 134, 144, 166

D

- Deformation cube 160
- Deformation diagram 30, 99
- Deformation to normal bundle 96, 142, 144, 160
- Dimension 6
- Direct images 105
- Double complex 140
- Doubly variant functor 37

E

- Eigenspace decomposition for Adams character 60
- Elementary imbedding 32, 37, 57, 68, 142, 146
- Elementary projection 32, 38, 57, 115, 117, 147
- Elementary square 158
- Exceptional divisor 91
- Excess conormal sheaf 153
- Excess dimension 153
- Extension of λ -ring K 4, 7, 115

F

- Filtration 48, 61, 117, 120, 124, 178, 182, 186
- Finite-dimensional λ -ring 6
- Fixed point formula 194
- Formal group 40
- Frobenius Riemann–Roch 195
- Functional of extension 10, 15, 117

G

- γ -filtration 48, 122, 124, 179, 182
- Graded degree 55, 65, 143, 183
- Graded filtration 48
- Graded K 54, 61
- Graded splitting 49

Grothendieck filtration 48
 Grothendieck group 102
 Grothendieck operations 47
 Grothendieck Riemann–Roch 146

H

Hirzebruch–Newton polynomials 23
 Hirzebruch polynomials 17
 Hirzebruch Riemann–Roch 148
 Homology isomorphism 140
 Howe’s proof 34
 Hyperplane at infinity 68

I

Imbedding 68
 Integral Riemann–Roch 43, 46, 148
 Intersection formula 131, 155, 157
 Involution 20

K

K -functor 134
 K of blow up 169
 K of projective bundle 115
 $K(X)$ 103
 Key formula 155, 156
 Koszul complex 70, 76, 106
 Koszul resolution 76, 107

L

λ -dimension 6
 λ -operations 3
 λ -ring 3, 103
 λ -ring functor 37, 139, 157
 Lefschetz Riemann–Roch 194
 Line elements 4, 53, 103
 Local complete intersection 86
 Locally free sheaf 67, 100
 Locally free resolution 100, 126
 Lower filtration 178
 Lower grading 180
 Lower K 164

M

Meet regularly 80, 128, 131
 Micali’s theorem 73
 Multiplier 24, 28, 157, 171

N

Newton polynomial 23
 Nilpotence 52, 125

P

Pic 53, 103
 Poincaré homomorphism 165, 181
 Positive element 3
 Positive structure 3, 9
 Principal element 32
 Projection formula 28, 118, 128, 139,
 167, 184, 186
 Projective bundle 67, 104, 115
 Projective completion 69
 Proper intersection 153, 155
 Proper transform 94
 Push forward 116, 127, 134, 144, 166

Q

Quasi-equal 111
 Quasi-finitely generated 111
 Quillen’s proof 114

R

Regular complex 123
 Regular imbedding 77, 126
 Regular intersection 131
 Regular morphism 86, 134
 Regular section 76
 Regular sequence 71
 Regular sheaf 107
 Relative dimension 89
 Represented by a complex 119
 Residual scheme 93
 Resolution 76, 100, 113, 126
 Restricted morphism 157
 Riemann–Roch, Adams and
 Grothendieck 63, 142, 146, 149
 Riemann–Roch character 28
 Riemann–Roch element 45
 Riemann–Roch functor 28
 Riemann–Roch for imbeddings 32
 Riemann–Roch multiplier 28
 Riemann–Roch for projections 33

S

Self intersection 155, 171
 Singular Riemann–Roch 188
 Smooth 81

Special λ -ring 6
Splitting principle 13
Splitting property 4, 49, 118
Staircase decomposition 87
Star multiplication 177
Support 119
Symmetric functions 4
Symmetric powers 7, 117

T

Tangent bundle 144
Tangent element 144
Tautological exact sequence 67
Todd class 20, 188
Todd homomorphism 19, 20, 24
Top Chern class 14
Top graded degree 147, 181
Topological filtration 120, 122, 125,
179, 181

Total Chern class 13
Total complex 140

U

Universal exact sequence 67
Universal hyperplane sheaf 67, 68
Universal polynomials 5
Upper K 164
Upper and lower filtration 178

V

Vector bundle 68
Verdier Riemann–Roch 189
Virtual tangent bundle 144

Z

Zero scheme 76, 128
Zero section 68

Grundlehren der mathematischen Wissenschaften

Continued from page ii

235. Dynkin/Yushkevich: Markov Control Processes and Their Applications
236. Grauert/Remmert: Theory of Stein Spaces
237. Köthe: Topological Vector-Spaces II
238. Graham/McGehee: Essays in Commutative Harmonic Analysis
239. Elliott: Probabilistic Number Theory I
240. Elliott: Probabilistic Number Theory II
241. Rudin: Function Theory in the Unit Ball of C^n
242. Huppert/Blackburn: Finite Groups I
243. Huppert/Blackburn: Finite Groups II
244. Kubert/Lang: Modular Units
245. Cornfeld/Fomin/Sinai: Ergodic Theory
246. Naimark/Štern: Theory of Group Representations
247. Suzuki: Group Theory I
249. Chung: Lectures from Markov Processes to Brownian Motion
250. Arnold: Geometrical Methods in the Theory of Ordinary Differential Equations
251. Chow/Hale: Methods of Bifurcation Theory
252. Aubin: Nonlinear Analysis on Manifolds, Monge-Ampère Equations
253. Dwork: Lectures on p -adic Differential Equations
254. Freitag: Siegel'sche Modulfunktionen
255. Lang: Complex Multiplication
256. Hörmander: The Analysis of Linear Partial Differential Operators I
257. Hörmander: The Analysis of Linear Partial Differential Operators II
258. Smoller: Shock Waves and Reaction-Diffusion Equations
259. Duren: Univalent Functions
260. Freidlin/Wentzell: Random Perturbations of Dynamical Systems
261. Remmert/Bosch/Güntzer: Non Archimedean Analysis—A Systematic Approach to Rigid Analytic Geometry
262. Doob: Classical Potential Theory & Its Probabilistic Counterpart
263. Krasnosel'skiĭ/Zabreĭko: Geometrical Methods of Nonlinear Analysis
264. Aubin/Cellina: Differential Inclusions
265. Grauert/Remmert: Coherent Analytic Sheaves
266. de Rham: Differentiable Manifolds
267. Arbarello/Cornalba/Griffiths/Harris: Geometry of Algebraic Curves, Vol. I
268. Arbarello/Cornalba/Griffiths/Harris: Geometry of Algebraic Curves, Vol. II
269. Schapira: Microdifferential Systems in the Complex Domain
270. Scharlau: Quadratic and Hermitian Forms
271. Ellis: Entropy, Large Deviations, and Statistical Mechanics
272. Elliott: Arithmetic Functions and Integer Products
273. Nikolskij: Treatise on Shift Operators
274. Hörmander: The Analysis of Linear Partial Differential Operators III
275. Hörmander: The Analysis of Linear Partial Differential Operators IV
276. Liggett: Interacting Particle Systems
277. Fulton/Lang: Riemann-Roch Algebra
278. Barr/Wells: Toposes, Triples, and Theories
279. Bishop/Bridges: Constructive Analysis