MSC2020-Mathematical Sciences Classification System

Associate Editors of Mathematical Reviews and zbMATH

00 General and overarching topics; collections
01 History and biography
03 Mathematical logic and foundations
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic systems
11 Number theory
12 Field theory and polynomials
13 Commutative algebra
14 Algebraic geometry
15 Linear and multilinear algebra; matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory; homological algebra
19 K-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
37 Dynamical systems and ergodic theory
39 Difference and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Harmonic analysis on Euclidean spaces
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control; optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Operations research, mathematical programming
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory; control
94 Information and communication, circuits
97 Mathematics education
This document is a printed form of MSC2020, an MSC revision produced jointly by the editorial staffs of Mathematical Reviews (MR) and Zentralblatt für Mathematik (zbMATH) in consultation with the mathematical community. The goals of this revision of the Mathematics Subject Classification (MSC) were set out in the announcement of it and call for comments by the Executive Editor of MR and the Chief Editor of zbMATH in July 2016. This document results from the MSC revision process that has been going on since then. MSC2020 will be fully deployed from January 2020.

The editors of MR and zbMATH deploying this revision therefore ask for feedback on remaining errors to help in this work, which should be given through e-mail to feedback@msc2020.org. They are grateful for the many suggestions that were received previously, which have greatly influenced what we have.
How to use the Mathematics Subject Classification [MSC]

The main purpose of the classification of items in the mathematical literature using the Mathematics Subject Classification scheme is to help users find the items of present or potential interest to them as readily as possible—in products derived from the Mathematical Reviews Database (MRDB) such as MathSciNet, in Zentralblatt MATH (zbMATH), or anywhere else where this classification scheme is used. An item in the mathematical literature should be classified so as to attract the attention of all those possibly interested in it. The item may be something that falls squarely within one clear area of the MSC, or it may involve several areas. Ideally, the MSC codes attached to an item should represent the subjects to which the item contains a contribution. The classification should serve both those closely concerned with specific subject areas, and those familiar enough with subjects to apply their results and methods elsewhere, inside or outside of mathematics. It will be extremely useful for both users and classifiers to familiarize themselves with the entire classification system and thus to become aware of all the classifications of possible interest to them. Every item in the MRDB or zbMATH receives precisely one primary classification, which is simply the MSC code that describes its principal contribution. When an item contains several principal contributions to different areas, the primary classification should cover the most important among them. A paper or book may be assigned one or several secondary classification numbers to cover any remaining principal contributions, ancillary results, motivation or origin of the matters discussed, intended or potential field of application, or other significant aspects worthy of notice. The principal contribution is meant to be the one including the most important part of the work actually done in the item. For example, a paper whose main overall content is the solution of a problem in graph theory, which arose in computer science and whose solution is (perhaps) at present only of interest to computer scientists, would have a primary classification in 05C (Graph Theory) with one or more secondary classifications in 68 (Computer Science); conversely, a paper whose overall content lies mainly in computer science should receive a primary classification in 68, even if it makes heavy use of graph theory and proves several new graph-theoretic results along the way. There are two types of cross-references given at the end of many of the MSC2020 entries in the MSC. The first type is in braces: “{For A, see X}”; if this appears in section Y, it means that contributions described by A should usually be assigned the classification code X, not Y. The other type of cross-reference merely points out related classifications; it is in brackets: “[See also ... ]”, “[See mainly ... ]”, etc., and the classification codes listed in the brackets may, but need not, be included in the classification codes of a paper, or they may be used in place of the classification where the cross-reference is given. The classifier must judge which classification is the most appropriate for the paper at hand.
00-XX General and overarching topics; collections

00-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mathematics in general

00-02 Research exposition (monographs, survey articles) pertaining to mathematics in general

00Axx General and miscellaneous specific topics

00A05 Mathematics in general

00A06 Mathematics for nonmathematicians (engineering, social sciences, etc.)

00A07 Problem books {For open problems, see 00A27}

00A08 Recreational mathematics

00A09 Popularization of mathematics

00A15 Bibliographies for mathematics in general [See also 01A70 and the classification number –00 in the other sections]

00A17 External book reviews

00A20 Dictionaries and other general reference works [See also the classification number –00 in the other sections]

00A22 Formularies

00A27 Lists of open problems

00A30 Philosophy of mathematics [See also 03A05]

00A35 Methodology of mathematics {For mathematics education, see 97-XX}

00A64 Mathematics and literature

00A65 Mathematics and music

00A66 Mathematics and visual arts

00A67 Mathematics and architecture

00A69 General applied mathematics {For physics, see 00A79 and Sections 70 through 86}

00A71 General theory of mathematical modeling

00A72 General theory of simulation

00A79 Physics (Use more specific entries from Sections 70 through 86 when possible)

00A99 None of the above, but in this section

00Bxx Conference proceedings and collections of articles

00B05 Collections of abstracts of lectures

00B10 Collections of articles of general interest

00B15 Collections of articles of miscellaneous specific interest

00B20 Proceedings of conferences of general interest

00B25 Proceedings of conferences of miscellaneous specific interest

00B30 Festschriften
00B50 Collections of translated articles of general interest
00B55 Collections of translated articles of miscellaneous specific interest
00B60 Collections of reprinted articles [See also 01A75]
00B99 None of the above, but in this section

01-XX History and biography [See also the classification number –03 in the other sections]

01-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to history and biography
01-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to history and biography
01-02 Research exposition (monographs, survey articles) pertaining to history and biography
01-06 Proceedings, conferences, collections, etc. pertaining to history and biography
01-11 Research data for problems pertaining to history and biography

01Axx History of mathematics and mathematicians

01A05 General histories, source books
01A07 Ethnomathematics, general
01A10 History of mathematics in Paleolithic and Neolithic times
01A11 History of mathematics of the indigenous cultures of Africa, Asia, and Oceania
01A12 History of mathematics of the indigenous cultures of the Americas
01A15 History of mathematics of the indigenous cultures of Europe (pre-Greek, etc.)
01A16 History of mathematics in Ancient Egypt
01A17 History of mathematics in Ancient Babylon
01A20 History of mathematics in Ancient Greece and Rome
01A25 History of mathematics in China
01A27 History of mathematics in Japan
01A29 History of mathematics in Southeast Asia
01A30 History of mathematics in the Golden Age of Islam
01A32 History of mathematics in India
01A35 History of mathematics in late antiquity and medieval Europe
01A40 History of mathematics in the 15th and 16th centuries, Renaissance
01A45 History of mathematics in the 17th century
01A50 History of mathematics in the 18th century
01A55 History of mathematics in the 19th century
01A60 History of mathematics in the 20th century
01A61 History of mathematics in the 21st century
01A65 Development of contemporary mathematics
01A67 Future perspectives in mathematics
01A70 Biographies, obituaries, personalia, bibliographies
01A72 Schools of mathematics
01A73 History of mathematics at specific universities
01A74 History of mathematics at institutions and academies (non-university)
01A75 Collected or selected works; reprints or translations of classics [See also 00B60]
01A80 Sociology (and profession) of mathematics
01A85 Historiography
01A90 Bibliographic studies
01A99 None of the above, but in this section

03-XX Mathematical logic and foundations

03-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to mathematical logic and foundations
03-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mathematical logic and foundations
03-02 Research exposition (monographs, survey articles) pertaining to mathematical logic and foundations
03-03 History of mathematical logic and foundations [Consider also classification numbers pertaining to Section 01]
03-04 Software, source code, etc. for problems pertaining to mathematical logic and foundations
03-06 Proceedings, conferences, collections, etc. pertaining to mathematical logic and foundations
03-08 Computational methods for problems pertaining to mathematical logic and foundations
03-11 Research data for problems pertaining to mathematical logic and foundations

03Axx Philosophical aspects of logic and foundations

03A05 Philosophical and critical aspects of logic and foundations {For philosophy of mathematics, see also 00A30}
03A10 Logic in the philosophy of science
03A99 None of the above, but in this section
03Bxx General logic

03B05 Classical propositional logic

03B10 Classical first-order logic

03B16 Higher-order logic

03B20 Subsystems of classical logic (including intuitionistic logic)

03B22 Abstract deductive systems

03B25 Decidability of theories and sets of sentences [See also 11U05, 12L05, 20F10]

03B30 Foundations of classical theories (including reverse mathematics) [See also 03F35]

03B35 Mechanization of proofs and logical operations [See also 68V15]

03B38 Type theory

03B40 Combinatory logic and lambda calculus [See also 68N18]

03B42 Logics of knowledge and belief (including belief change)

03B44 Temporal logic

03B45 Modal logic (including the logic of norms) {For knowledge and belief, see 03B42; for temporal logic, see 03B44; for provability logic, see also 03F45}

03B47 Substructural logics (including relevance, entailment, linear logic, Lambek calculus, BCK and BCI logics) {For proof-theoretic aspects see 03F52}

03B48 Probability and inductive logic [See also 60A05]

03B50 Many-valued logic

03B52 Fuzzy logic; logic of vagueness [See also 68T27, 68T37, 94D05]

03B53 Paraconsistent logics

03B55 Intermediate logics

03B60 Other nonclassical logic

03B62 Combined logics

03B65 Logic of natural languages [See also 68T50, 91F20]

03B70 Logic in computer science [See also 68-XX]

03B80 Other applications of logic

03B99 None of the above, but in this section
03Cxx Model theory

03C05 Equational classes, universal algebra in model theory [See also 08Axx, 08Bxx, 18C05]

03C07 Basic properties of first-order languages and structures

03C10 Quantifier elimination, model completeness and related topics

03C13 Model theory of finite structures [See also 68Q15, 68Q19]

03C15 Model theory of denumerable and separable structures

03C20 Ultraproducts and related constructions

03C25 Model-theoretic forcing

03C30 Other model constructions

03C35 Categoricity and completeness of theories

03C40 Interpolation, preservation, definability

03C45 Classification theory, stability and related concepts in model theory [See also 03C48]

03C48 Abstract elementary classes and related topics [See also 03C45]

03C50 Models with special properties (saturated, rigid, etc.)

03C52 Properties of classes of models

03C55 Set-theoretic model theory

03C57 Computable structure theory, computable model theory [See also 03D45]

03C60 Model-theoretic algebra [See also 08C10, 12Lxx, 13L05]

03C62 Models of arithmetic and set theory [See also 03Hxx]

03C64 Model theory of ordered structures; o-minimality

03C65 Models of other mathematical theories

03C66 Continuous model theory, model theory of metric structures

03C68 Other classical first-order model theory

03C70 Logic on admissible sets

03C75 Other infinitary logic

03C80 Logic with extra quantifiers and operators [See also 03B42, 03B44, 03B45, 03B48]

03C85 Second- and higher-order model theory

03C90 Nonclassical models (Boolean-valued, sheaf, etc.)

03C95 Abstract model theory

03C98 Applications of model theory [See also 03C60]

03C99 None of the above, but in this section
### 03Dxx Computability and recursion theory

**03D03** Thue and Post systems, etc.

**03D05** Automata and formal grammars in connection with logical questions [See also 68Q45, 68Q70, 68R15]

**03D10** Turing machines and related notions [See also 68Q04]

**03D15** Complexity of computation (including implicit computational complexity) [See also 68Q15, 68Q17]

**03D20** Recursive functions and relations, subrecursive hierarchies

**03D25** Recursively (computably) enumerable sets and degrees

**03D28** Other Turing degree structures

**03D30** Other degrees and reducibilities in computability and recursion theory

**03D32** Algorithmic randomness and dimension [See also 68Q30]

**03D35** Undecidability and degrees of sets of sentences

**03D40** Word problems, etc. in computability and recursion theory [See also 06B25, 08A50, 20F10, 68R15]

**03D45** Theory of numerations, effectively presented structures [See also 03C57] {For intuitionistic and similar approaches, see 03F55}

**03D50** Recursive equivalence types of sets and structures, isols

**03D55** Hierarchies of computability and definability

**03D60** Computability and recursion theory on ordinals, admissible sets, etc.

**03D65** Higher-type and set recursion theory

**03D70** Inductive definability

**03D75** Abstract and axiomatic computability and recursion theory

**03D78** Computation over the reals, computable analysis {For constructive aspects, see 03F60}

**03D80** Applications of computability and recursion theory

**03D99** None of the above, but in this section

### 03Exx Set theory

**03E02** Partition relations

**03E04** Ordered sets and their cofinalities; pcf theory

**03E05** Other combinatorial set theory

**03E10** Ordinal and cardinal numbers

**03E15** Descriptive set theory [See also 28A05, 54H05]

**03E17** Cardinal characteristics of the continuum

**03E20** Other classical set theory (including functions, relations, and set algebra)

**03E25** Axiom of choice and related propositions

**03E30** Axiomatics of classical set theory and its fragments
03E35 Consistency and independence results
03E40 Other aspects of forcing and Boolean-valued models
03E45 Inner models, including constructibility, ordinal definability, and core models
03E47 Other notions of set-theoretic definability
03E50 Continuum hypothesis and Martin’s axiom [See also 03E57]
03E55 Large cardinals
03E57 Generic absoluteness and forcing axioms [See also 03E50]
03E60 Determinacy principles
03E65 Other set-theoretic hypotheses and axioms
03E70 Nonclassical and second-order set theories
03E72 Theory of fuzzy sets, etc.
03E75 Applications of set theory
03E99 None of the above, but in this section

03Fxx Proof theory and constructive mathematics
03F03 Proof theory, general (including proof-theoretic semantics)
03F05 Cut-elimination and normal-form theorems
03F07 Structure of proofs
03F10 Functionals in proof theory
03F15 Recursive ordinals and ordinal notations
03F20 Complexity of proofs
03F25 Relative consistency and interpretations
03F30 First-order arithmetic and fragments
03F35 Second- and higher-order arithmetic and fragments [See also 03B30]
03F40 Gödel numberings and issues of incompleteness
03F45 Provability logics and related algebras (e.g., diagonalizable algebras) [See also 03B45, 03G25, 06E25]
03F50 Metamathematics of constructive systems
03F52 Proof-theoretic aspects of linear logic and other substructural logics [See also 03B47]
03F55 Intuitionistic mathematics
03F60 Constructive and recursive analysis [See also 03B30, 03D45, 03D78, 26E40, 46S30, 47S30]
03F65 Other constructive mathematics [See also 03D45]
03F99 None of the above, but in this section
03Gxx Algebraic logic

03G05 Logical aspects of Boolean algebras [See also 06Exx]

03G10 Logical aspects of lattices and related structures [See also 06Bxx]

03G12 Quantum logic [See also 06C15, 81P10]

03G15 Cylindric and polyadic algebras; relation algebras

03G20 Logical aspects of Łukasiewicz and Post algebras [See also 06D25, 06D30]

03G25 Other algebras related to logic [See also 03F45, 06D20, 06E25, 06F35]

03G27 Abstract algebraic logic

03G30 Categorical logic, toposi [See also 18B25, 18C05, 18C10]

03G99 None of the above, but in this section

03Hxx Nonstandard models [See also 03C62]

03H05 Nonstandard models in mathematics [See also 26E35, 28E05, 30G06, 46S20, 47S20, 54J05]

03H10 Other applications of nonstandard models (economics, physics, etc.)

03H15 Nonstandard models of arithmetic [See also 11U10, 12L15, 13L05]

03H99 None of the above, but in this section

05-XX Combinatorics {For finite fields, see 11Txx}

05-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to combinatorics

05-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to combinatorics

05-02 Research exposition (monographs, survey articles) pertaining to combinatorics

05-03 History of combinatorics [Consider also classification numbers pertaining to Section 01]

05-04 Software, source code, etc. for problems pertaining to combinatorics

05-06 Proceedings, conferences, collections, etc. pertaining to combinatorics

05-08 Computational methods for problems pertaining to combinatorics

05-11 Research data for problems pertaining to combinatorics

05Axx Enumerative combinatorics {For enumeration in graph theory, see 05C30}

05A05 Permutations, words, matrices

05A10 Factorials, binomial coefficients, combinatorial functions [See also 11B65, 33Cxx]

05A15 Exact enumeration problems, generating functions [See also 33Cxx, 33Dxx]

05A16 Asymptotic enumeration

05A17 Combinatorial aspects of partitions of integers [See also 11P81, 11P82, 11P83]

05A18 Partitions of sets

05A19 Combinatorial identities, bijective combinatorics
05A20 Combinatorial inequalities
05A30 $q$-calculus and related topics [See also 33Dxx]
05A40 Umbral calculus
05A99 None of the above, but in this section

05Bxx Designs and configurations {For applications of design theory, see 94C30}
05B05 Combinatorial aspects of block designs [See also 51E05, 62K10]
05B07 Triple systems
05B10 Combinatorial aspects of difference sets (number-theoretic, group-theoretic, etc.) [See also 11B13]
05B15 Orthogonal arrays, Latin squares, Room squares
05B20 Combinatorial aspects of matrices (incidence, Hadamard, etc.)
05B25 Combinatorial aspects of finite geometries [See also 51D20, 51Exx]
05B30 Other designs, configurations [See also 51E30]
05B35 Combinatorial aspects of matroids and geometric lattices [See also 52B40, 90C27]
05B40 Combinatorial aspects of packing and covering [See also 11H31, 52C15, 52C17]
05B45 Combinatorial aspects of tessellation and tiling problems [See also 52C20, 52C22]
05B50 Polyominoes
05B99 None of the above, but in this section

05Cxx Graph theory {For applications of graphs, see 68R10, 81Q30, 81T15, 82B20, 82C20, 90C35, 92E10, 94C15}
05C05 Trees
05C07 Vertex degrees [See also 05E30]
05C09 Graphical indices (Wiener index, Zagreb index, Randić index, etc.)
05C10 Planar graphs; geometric and topological aspects of graph theory [See also 57K10, 57M15]
05C12 Distance in graphs
05C15 Coloring of graphs and hypergraphs
05C17 Perfect graphs
05C20 Directed graphs (digraphs), tournaments
05C21 Flows in graphs
05C22 Signed and weighted graphs
05C25 Graphs and abstract algebra (groups, rings, fields, etc.) [See also 20F65]
05C30 Enumeration in graph theory
05C31 Graph polynomials
05C35 Extremal problems in graph theory [See also 90C35]
05C38 Paths and cycles [See also 90B10]
05C40 Connectivity
05C42 Density (toughness, etc.)
05C45 Eulerian and Hamiltonian graphs
05C48 Expander graphs
05C50 Graphs and linear algebra (matrices, eigenvalues, etc.)
05C51 Graph designs and isomorphic decomposition [See also 05B30]
05C55 Generalized Ramsey theory [See also 05D10]
05C57 Games on graphs (graph-theoretic aspects) [See also 91A43, 91A46]
05C60 Isomorphism problems in graph theory (reconstruction conjecture, etc.) and homomorphisms (subgraph embedding, etc.)
05C62 Graph representations (geometric and intersection representations, etc.) {For graph drawing, see also 68R10}
05C63 Infinite graphs
05C65 Hypergraphs
05C69 Vertex subsets with special properties (dominating sets, independent sets, cliques, etc.)
05C70 Edge subsets with special properties (factorization, matching, partitioning, covering and packing, etc.)
05C72 Fractional graph theory, fuzzy graph theory
05C75 Structural characterization of families of graphs
05C76 Graph operations (line graphs, products, etc.)
05C78 Graph labelling (graceful graphs, bandwidth, etc.)
05C80 Random graphs (graph-theoretic aspects) [See also 60B20]
05C81 Random walks on graphs
05C82 Small world graphs, complex networks (graph-theoretic aspects) [See also 90Bxx, 91D30]
05C83 Graph minors
05C85 Graph algorithms (graph-theoretic aspects) [See also 68R10, 68W05]
05C90 Applications of graph theory [See also 68R10, 81Q30, 81T15, 82B20, 82C20, 90C35, 92E10, 94C15]
05C92 Chemical graph theory [See also 92E10]
05C99 None of the above, but in this section

05Dxx Extremal combinatorics
05D05 Extremal set theory
05D10 Ramsey theory [See also 05C55]
05D15 Transversal (matching) theory
05D40 Probabilistic methods in extremal combinatorics, including polynomial methods (combinatorial Nullstellensatz, etc.)
05D99 None of the above, but in this section
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>05Exx</td>
<td>Algebraic combinatorics</td>
</tr>
<tr>
<td>05E05</td>
<td>Symmetric functions and generalizations</td>
</tr>
<tr>
<td>05E10</td>
<td>Combinatorial aspects of representation theory [See also 20C30]</td>
</tr>
<tr>
<td>05E14</td>
<td>Combinatorial aspects of algebraic geometry [See also 14Nxx]</td>
</tr>
<tr>
<td>05E16</td>
<td>Combinatorial aspects of groups and algebras [See also 22E45, 33C80]</td>
</tr>
<tr>
<td>05E18</td>
<td>Group actions on combinatorial structures</td>
</tr>
<tr>
<td>05E30</td>
<td>Association schemes, strongly regular graphs</td>
</tr>
<tr>
<td>05E40</td>
<td>Combinatorial aspects of commutative algebra</td>
</tr>
<tr>
<td>05E45</td>
<td>Combinatorial aspects of simplicial complexes</td>
</tr>
<tr>
<td>05E99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>06-XX</td>
<td>Order, lattices, ordered algebraic structures [See also 18B35]</td>
</tr>
<tr>
<td>06-00</td>
<td>General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to ordered structures</td>
</tr>
<tr>
<td>06-01</td>
<td>Introductory exposition (textbooks, tutorial papers, etc.) pertaining to ordered structures</td>
</tr>
<tr>
<td>06-02</td>
<td>Research exposition (monographs, survey articles) pertaining to ordered structures</td>
</tr>
<tr>
<td>06-03</td>
<td>History of ordered structures [Consider also classification numbers pertaining to Section 01]</td>
</tr>
<tr>
<td>06-04</td>
<td>Software, source code, etc. for problems pertaining to ordered structures</td>
</tr>
<tr>
<td>06-06</td>
<td>Proceedings, conferences, collections, etc. pertaining to ordered structures</td>
</tr>
<tr>
<td>06-08</td>
<td>Computational methods for problems pertaining to ordered structures</td>
</tr>
<tr>
<td>06-11</td>
<td>Research data for problems pertaining to ordered structures</td>
</tr>
<tr>
<td>06Axx</td>
<td>Ordered sets</td>
</tr>
<tr>
<td>06A05</td>
<td>Total orders</td>
</tr>
<tr>
<td>06A06</td>
<td>Partial orders, general</td>
</tr>
<tr>
<td>06A07</td>
<td>Combinatorics of partially ordered sets</td>
</tr>
<tr>
<td>06A11</td>
<td>Algebraic aspects of posets</td>
</tr>
<tr>
<td>06A12</td>
<td>Semilattices [See also 20M10] {For topological semilattices, see 22A26}</td>
</tr>
<tr>
<td>06A15</td>
<td>Galois correspondences, closure operators (in relation to ordered sets)</td>
</tr>
<tr>
<td>06A75</td>
<td>Generalizations of ordered sets</td>
</tr>
<tr>
<td>06A99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
06Bxx Lattices [See also 03G10]
06B05 Structure theory of lattices
06B10 Lattice ideals, congruence relations
06B15 Representation theory of lattices
06B20 Varieties of lattices
06B23 Complete lattices, completions
06B25 Free lattices, projective lattices, word problems [See also 03D40, 08A50, 20F10]
06B30 Topological lattices [See also 06F30, 22A26, 54F05, 54H12]
06B35 Continuous lattices and posets, applications [See also 06B30, 06D10, 06F30, 18B35, 22A26, 68Q55]
06B75 Generalizations of lattices
06B99 None of the above, but in this section

06Cxx Modular lattices, complemented lattices
06C05 Modular lattices, Desarguesian lattices
06C10 Semimodular lattices, geometric lattices
06C15 Complemented lattices, orthocomplemented lattices and posets [See also 03G12, 81P10]
06C20 Complemented modular lattices, continuous geometries
06C99 None of the above, but in this section

06Dxx Distributive lattices
06D05 Structure and representation theory of distributive lattices
06D10 Complete distributivity
06D15 Pseudocomplemented lattices
06D20 Heyting algebras (lattice-theoretic aspects) [See also 03G25]
06D22 Frames, locales {For topological questions, see 54-XX}
06D25 Post algebras (lattice-theoretic aspects) [See also 03G20]
06D30 De Morgan algebras, Lukasiewicz algebras (lattice-theoretic aspects) [See also 03G20]
06D35 MV-algebras
06D50 Lattices and duality
06D72 Fuzzy lattices (soft algebras) and related topics
06D75 Other generalizations of distributive lattices
06D99 None of the above, but in this section
06Exx Boolean algebras (Boolean rings) [See also 03G05]
06E05 Structure theory of Boolean algebras
06E10 Chain conditions, complete algebras
06E15 Stone spaces (Boolean spaces) and related structures
06E20 Ring-theoretic properties of Boolean algebras [See also 16E50, 16G30]
06E25 Boolean algebras with additional operations (diagonalizable algebras, etc.) [See also 03G25, 03F45]
06E30 Boolean functions [See also 94D10]
06E75 Generalizations of Boolean algebras
06E99 None of the above, but in this section

06Fxx Ordered structures
06F05 Ordered semigroups and monoids [See also 20Mxx]
06F07 Quantales
06F10 Noether lattices
06F15 Ordered groups [See also 20F60]
06F20 Ordered abelian groups, Riesz groups, ordered linear spaces [See also 46A40]
06F25 Ordered rings, algebras, modules {For ordered fields, see 12J15} [See also 13J25, 16W80]
06F30 Ordered topological structures (aspects of ordered structures) [See also 06B30, 22A26, 54F05, 54H12]
06F35 BCK-algebras, BCI-algebras (aspects of ordered structures) [See also 03G25]
06F99 None of the above, but in this section

08-XX General algebraic systems
08-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to general algebraic systems
08-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to general algebraic systems
08-02 Research exposition (monographs, survey articles) pertaining to general algebraic systems
08-03 History of general algebraic systems [Consider also classification numbers pertaining to Section 01]
08-04 Software, source code, etc. for problems pertaining to general algebraic systems
08-06 Proceedings, conferences, collections, etc. pertaining to general algebraic systems
08-08 Computational methods for problems pertaining to general algebraic systems
08-11 Research data for problems pertaining to general algebraic systems
08Axx Algebraic structures [See also 03C05]
08A02 Relational systems, laws of composition
08A05 Structure theory of algebraic structures
08A30 Subalgebras, congruence relations
08A35 Automorphisms and endomorphisms of algebraic structures
08A40 Operations and polynomials in algebraic structures, primal algebras
08A45 Equational compactness
08A50 Word problems (aspects of algebraic structures) [See also 03D40, 06B25, 20F10, 68R15]
08A55 Partial algebras
08A60 Unary algebras
08A62 Finitary algebras
08A65 Infinitary algebras
08A68 Heterogeneous algebras
08A70 Applications of universal algebra in computer science
08A72 Fuzzy algebraic structures
08A99 None of the above, but in this section

08Bxx Varieties [See also 03C05]
08B05 Equational logic, Mal’tsev conditions
08B10 Congruence modularity, congruence distributivity
08B15 Lattices of varieties
08B20 Free algebras
08B25 Products, amalgamated products, and other kinds of limits and colimits [See also 18A30]
08B26 Subdirect products and subdirect irreducibility
08B30 Injectives, projectives
08B99 None of the above, but in this section

08Cxx Other classes of algebras
08C05 Categories of algebras [See also 18C05]
08C10 Axiomatic model classes [See also 03Cxx, in particular 03C60]
08C15 Quasivarieties
08C20 Natural dualities for classes of algebras [See also 06E15, 18A40, 22A30]
08C99 None of the above, but in this section
11-XX Number theory

11-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to number theory
11-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to number theory
11-02 Research exposition (monographs, survey articles) pertaining to number theory
11-03 History of number theory [Consider also classification numbers pertaining to Section 01]
11-04 Software, source code, etc. for problems pertaining to number theory
11-06 Proceedings, conferences, collections, etc. pertaining to number theory
11-11 Research data for problems pertaining to number theory

11Axx Elementary number theory {For analogues in number fields, see 11R04}
11A05 Multiplicative structure; Euclidean algorithm; greatest common divisors
11A07 Congruences; primitive roots; residue systems
11A15 Power residues, reciprocity
11A25 Arithmetic functions; related numbers; inversion formulas
11A41 Primes
11A51 Factorization; primality
11A55 Continued fractions {For approximation results, see 11J70} [See also 11K50, 30B70, 40A15]
11A63 Radix representation; digital problems {For metric results, see 11K16}
11A67 Other number representations
11A99 None of the above, but in this section

11Bxx Sequences and sets
11B05 Density, gaps, topology
11B13 Additive bases, including sumsets [See also 05B10]
11B25 Arithmetic progressions [See also 11N13]
11B30 Arithmetic combinatorics; higher degree uniformity
11B34 Representation functions
11B37 Recurrences {For applications to special functions, see 33-XX}
11B39 Fibonacci and Lucas numbers and polynomials and generalizations
11B50 Sequences (mod m)
11B57 Farey sequences; the sequences $1^k, 2^k, \ldots$
11B65 Binomial coefficients; factorials; $q$-identities [See also 05A10, 05A30]
11B68 Bernoulli and Euler numbers and polynomials
11B73 Bell and Stirling numbers
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11B75</td>
<td>Other combinatorial number theory</td>
</tr>
<tr>
<td>11B83</td>
<td>Special sequences and polynomials</td>
</tr>
<tr>
<td>11B85</td>
<td>Automata sequences</td>
</tr>
<tr>
<td>11B99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>11Cxx</td>
<td>Polynomials and matrices</td>
</tr>
<tr>
<td>11C08</td>
<td>Polynomials in number theory [See also 13F20]</td>
</tr>
<tr>
<td>11C20</td>
<td>Matrices, determinants in number theory [See also 15B36]</td>
</tr>
<tr>
<td>11C99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>11Dxx</td>
<td>Diophantine equations [See also 11Gxx, 14Gxx]</td>
</tr>
<tr>
<td>11D04</td>
<td>Linear Diophantine equations</td>
</tr>
<tr>
<td>11D07</td>
<td>The Frobenius problem</td>
</tr>
<tr>
<td>11D09</td>
<td>Quadratic and bilinear Diophantine equations</td>
</tr>
<tr>
<td>11D25</td>
<td>Cubic and quartic Diophantine equations</td>
</tr>
<tr>
<td>11D41</td>
<td>Higher degree equations; Fermat’s equation</td>
</tr>
<tr>
<td>11D45</td>
<td>Counting solutions of Diophantine equations</td>
</tr>
<tr>
<td>11D57</td>
<td>Multiplicative and norm form equations</td>
</tr>
<tr>
<td>11D59</td>
<td>Thue-Mahler equations</td>
</tr>
<tr>
<td>11D61</td>
<td>Exponential Diophantine equations</td>
</tr>
<tr>
<td>11D68</td>
<td>Rational numbers as sums of fractions</td>
</tr>
<tr>
<td>11D72</td>
<td>Diophantine equations in many variables [See also 11P55]</td>
</tr>
<tr>
<td>11D75</td>
<td>Diophantine inequalities [See also 11J25]</td>
</tr>
<tr>
<td>11D79</td>
<td>Congruences in many variables</td>
</tr>
<tr>
<td>11D85</td>
<td>Representation problems [See also 11P55]</td>
</tr>
<tr>
<td>11D88</td>
<td>$p$-adic and power series fields</td>
</tr>
<tr>
<td>11D99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>11Exx</td>
<td>Forms and linear algebraic groups [See also 19Gxx] {For quadratic forms in linear algebra, see 15A63}</td>
</tr>
<tr>
<td>11E04</td>
<td>Quadratic forms over general fields</td>
</tr>
<tr>
<td>11E08</td>
<td>Quadratic forms over local rings and fields</td>
</tr>
<tr>
<td>11E10</td>
<td>Forms over real fields</td>
</tr>
<tr>
<td>11E12</td>
<td>Quadratic forms over global rings and fields</td>
</tr>
<tr>
<td>11E16</td>
<td>General binary quadratic forms</td>
</tr>
</tbody>
</table>
11E20 General ternary and quaternary quadratic forms; forms of more than two variables
11E25 Sums of squares and representations by other particular quadratic forms
11E39 Bilinear and Hermitian forms
11E41 Class numbers of quadratic and Hermitian forms
11E45 Analytic theory (Epstein zeta functions; relations with automorphic forms and functions)
11E57 Classical groups [See also 14Lxx, 20Gxx]
11E70 K-theory of quadratic and Hermitian forms
11E72 Galois cohomology of linear algebraic groups [See also 20G10]
11E76 Forms of degree higher than two
11E81 Algebraic theory of quadratic forms; Witt groups and rings [See also 19G12, 19G24]
11E88 Quadratic spaces; Clifford algebras [See also 15A63, 15A66]
11E95 p-adic theory
11E99 None of the above, but in this section

11Fxx Discontinuous groups and automorphic forms [See also 11R39, 11S37, 14Gxx, 14Kxx, 22E50, 22E55, 30F35, 32Nxx] {For relations with quadratic forms, see 11E45}
11F03 Modular and automorphic functions
11F06 Structure of modular groups and generalizations; arithmetic groups [See also 20H05, 20H10, 22E40]
11F11 Holomorphic modular forms of integral weight
11F12 Automorphic forms, one variable
11F20 Dedekind eta function, Dedekind sums
11F22 Relationship to Lie algebras and finite simple groups
11F23 Relations with algebraic geometry and topology
11F25 Hecke-Petersson operators, differential operators (one variable)
11F27 Theta series; Weil representation; theta correspondences
11F30 Fourier coefficients of automorphic forms
11F32 Modular correspondences, etc.
11F33 Congruences for modular and p-adic modular forms [See also 14G20, 22E50]
11F37 Forms of half-integer weight; nonholomorphic modular forms
11F41 Automorphic forms on GL(2); Hilbert and Hilbert-Siegel modular groups and their modular and automorphic forms; Hilbert modular surfaces [See also 14J20]
11F46 Siegel modular groups; Siegel and Hilbert-Siegel modular and automorphic forms
11F50 Jacobi forms
11F52 Modular forms associated to Drinfel’d modules
11F55 Other groups and their modular and automorphic forms (several variables)
11F60 Hecke-Petersson operators, differential operators (several variables)
11F66 Langlands $L$-functions; one variable Dirichlet series and functional equations
11F67 Special values of automorphic $L$-series, periods of automorphic forms, cohomology, modular symbols
11F68 Dirichlet series in several complex variables associated to automorphic forms; Weyl group multiple Dirichlet series
11F70 Representation-theoretic methods; automorphic representations over local and global fields
11F72 Spectral theory; trace formulas (e.g., that of Selberg)
11F75 Cohomology of arithmetic groups
11F77 Automorphic forms and their relations with perfectoid spaces [See also 14G45]
11F80 Galois representations
11F85 $p$-adic theory, local fields [See also 14G20, 22E50]
11F99 None of the above, but in this section

11Gxx Arithmetic algebraic geometry (Diophantine geometry) [See also 11Dxx, 14Gxx, 14Kxx]
11G05 Elliptic curves over global fields [See also 14H52]
11G07 Elliptic curves over local fields [See also 14G20, 14H52]
11G09 Drinfel’d modules; higher-dimensional motives, etc. [See also 14L05]
11G10 Abelian varieties of dimension > 1 [See also 14Kxx]
11G15 Complex multiplication and moduli of abelian varieties [See also 14K22]
11G16 Elliptic and modular units [See also 11R27]
11G18 Arithmetic aspects of modular and Shimura varieties [See also 14G35]
11G20 Curves over finite and local fields [See also 14H25]
11G25 Varieties over finite and local fields [See also 14G15, 14G20]
11G30 Curves of arbitrary genus or genus $\neq 1$ over global fields [See also 14H25]
11G32 Arithmetic aspects of dessins d’enfants, Belyï theory
11G35 Varieties over global fields [See also 14G25]
11G40 $L$-functions of varieties over global fields; Birch-Swinnerton-Dyer conjecture [See also 14G10]
11G42 Arithmetic mirror symmetry [See also 14J33]
11G45 Geometric class field theory [See also 11R37, 14C35, 19F05]
11G50 Heights [See also 14G40, 37P30]
11G55 Polylogarithms and relations with $K$-theory
11G99 None of the above, but in this section
11Hxx Geometry of numbers {For applications in coding theory, see 94B75}

11H06 Lattices and convex bodies (number-theoretic aspects) [See also 11P21, 52C05, 52C07]
11H16 Nonconvex bodies
11H31 Lattice packing and covering (number-theoretic aspects) [See also 05B40, 52C15, 52C17]
11H46 Products of linear forms
11H50 Minima of forms
11H55 Quadratic forms (reduction theory, extreme forms, etc.)
11H56 Automorphism groups of lattices
11H60 Mean value and transfer theorems
11H71 Relations with coding theory
11H99 None of the above, but in this section

11Jxx Diophantine approximation, transcendental number theory [See also 11K60]

11J04 Homogeneous approximation to one number
11J06 Markov and Lagrange spectra and generalizations
11J13 Simultaneous homogeneous approximation, linear forms
11J17 Approximation by numbers from a fixed field
11J20 Inhomogeneous linear forms
11J25 Diophantine inequalities [See also 11D75]
11J54 Small fractional parts of polynomials and generalizations
11J61 Approximation in non-Archimedean valuations
11J68 Approximation to algebraic numbers
11J70 Continued fractions and generalizations [See also 11A55, 11K50]
11J71 Distribution modulo one [See also 11K06]
11J72 Irrationality; linear independence over a field
11J81 Transcendence (general theory)
11J82 Measures of irrationality and of transcendence
11J83 Metric theory
11J85 Algebraic independence; Gel’fond’s method
11J86 Linear forms in logarithms; Baker’s method
11J87 Schmidt Subspace Theorem and applications
11J89 Transcendence theory of elliptic and abelian functions
11J91 Transcendence theory of other special functions
11J93 Transcendence theory of Drinfel’d and t-modules
11J95 Results involving abelian varieties
11J97 Number-theoretic analogues of methods in Nevanlinna theory (work of Vojta et al.)
11J99 None of the above, but in this section
11Kxx Probabilistic theory: distribution modulo 1; metric theory of algorithms

11K06 General theory of distribution modulo 1 [See also 11J71]

11K16 Normal numbers, radix expansions, Pisot numbers, Salem numbers, good lattice points, etc. [See also 11A63]

11K31 Special sequences

11K36 Well-distributed sequences and other variations

11K38 Irregularities of distribution, discrepancy [See also 11Nxx]

11K41 Continuous, p-adic and abstract analogues

11K45 Pseudo-random numbers; Monte Carlo methods [See also 65C05, 65C10]

11K50 Metric theory of continued fractions [See also 11A55, 11J70]

11K55 Metric theory of other algorithms and expansions; measure and Hausdorff dimension [See also 11N99, 28Dxx]

11K60 Diophantine approximation in probabilistic number theory [See also 11Jxx]

11K65 Arithmetic functions in probabilistic number theory [See also 11Nxx]

11K70 Harmonic analysis and almost periodicity in probabilistic number theory

11K99 None of the above, but in this section

11Lxx Exponential sums and character sums {For finite fields, see 11Txx}

11L03 Trigonometric and exponential sums, general

11L05 Gauss and Kloosterman sums; generalizations

11L07 Estimates on exponential sums

11L10 Jacobsthal and Brewer sums; other complete character sums

11L15 Weyl sums

11L20 Sums over primes

11L26 Sums over arbitrary intervals

11L40 Estimates on character sums

11L99 None of the above, but in this section

11Mxx Zeta and L-functions: analytic theory

11M06 \(\zeta(s)\) and \(L(s, \chi)\)

11M20 Real zeros of \(L(s, \chi)\): results on \(L(1, \chi)\)

11M26 Nonreal zeros of \(\zeta(s)\) and \(L(s, \chi)\): Riemann and other hypotheses

11M32 Multiple Dirichlet series and zeta functions and multizeta values

11M35 Hurwitz and Lerch zeta functions

11M36 Selberg zeta functions and regularized determinants; applications to spectral theory, Dirichlet series, Eisenstein series, etc. (explicit formulas)

11M38 Zeta and \(L\)-functions in characteristic \(p\)
11M41 Other Dirichlet series and zeta functions \{For local and global ground fields, see 11R42, 11R52, 11S40, 11S45; for algebro-geometric methods, see 14G10\} [See also 11E45, 11F66, 11F70, 11F72]

11M45 Tauberian theorems [See also 40E05]

11M50 Relations with random matrices

11M55 Relations with noncommutative geometry

11M99 None of the above, but in this section

11Nxx Multiplicative number theory

11N05 Distribution of primes

11N13 Primes in congruence classes

11N25 Distribution of integers with specified multiplicative constraints

11N30 Turán theory [See also 30Bxx]

11N32 Primes represented by polynomials; other multiplicative structures of polynomial values

11N35 Sieves

11N36 Applications of sieve methods

11N37 Asymptotic results on arithmetic functions

11N45 Asymptotic results on counting functions for algebraic and topological structures

11N56 Rate of growth of arithmetic functions

11N60 Distribution functions associated with additive and positive multiplicative functions

11N64 Other results on the distribution of values or the characterization of arithmetic functions

11N69 Distribution of integers in special residue classes

11N75 Applications of automorphic functions and forms to multiplicative problems [See also 11Fxx]

11N80 Generalized primes and integers

11N99 None of the above, but in this section

11Pxx Additive number theory; partitions

11P05 Waring’s problem and variants

11P21 Lattice points in specified regions

11P32 Goldbach-type theorems; other additive questions involving primes

11P55 Applications of the Hardy-Littlewood method [See also 11D85]

11P70 Inverse problems of additive number theory, including sumsets

11P81 Elementary theory of partitions [See also 05A17]

11P82 Analytic theory of partitions

11P83 Partitions; congruences and congruential restrictions

11P84 Partition identities; identities of Rogers-Ramanujan type

11P99 None of the above, but in this section

24
11Rxx Algebraic number theory: global fields {For complex multiplication, see 11G15}

11R04 Algebraic numbers; rings of algebraic integers
11R06 PV-numbers and generalizations; other special algebraic numbers; Mahler measure
11R09 Polynomials (irreducibility, etc.)
11R11 Quadratic extensions
11R16 Cubic and quartic extensions
11R18 Cyclotomic extensions
11R20 Other abelian and metabelian extensions
11R21 Other number fields
11R23 Iwasawa theory
11R27 Units and factorization
11R29 Class numbers, class groups, discriminants
11R32 Galois theory
11R33 Integral representations related to algebraic numbers; Galois module structure of rings of integers [See also 20C10]
11R34 Galois cohomology [See also 12Gxx, 19A31]
11R37 Class field theory
11R39 Langlands-Weil conjectures, nonabelian class field theory [See also 11Fxx, 22E55]
11R42 Zeta functions and L-functions of number fields [See also 11M41, 19F27]
11R44 Distribution of prime ideals [See also 11N05]
11R45 Density theorems
11R47 Other analytic theory [See also 11Nxx]
11R52 Quaternion and other division algebras: arithmetic, zeta functions
11R54 Other algebras and orders, and their zeta and L-functions [See also 11S45, 16Hxx, 16Kxx]
11R56 Adèl e rings and groups
11R58 Arithmetic theory of algebraic function fields [See also 14-XX]
11R59 Zeta functions and L-functions of function fields
11R60 Cyclotomic function fields (class groups, Bernoulli objects, etc.)
11R65 Class groups and Picard groups of orders
11R70 K-theory of global fields [See also 19Fxx]
11R80 Totally real fields [See also 12J15]
11R99 None of the above, but in this section
11Sxx Algebraic number theory: local and \( p \)-adic fields

11S05 Polynomials

11S15 Ramification and extension theory

11S20 Galois theory

11S23 Integral representations

11S25 Galois cohomology [See also 12Gxx, 16H05]

11S31 Class field theory; \( p \)-adic formal groups [See also 14L05]

11S37 Langlands-Weil conjectures, nonabelian class field theory [See also 11Fxx, 22E50]

11S40 Zeta functions and \( L \)-functions [See also 11M41, 19F27]

11S45 Algebras and orders, and their zeta functions [See also 11R52, 11R54, 16Hxx, 16Kxx]

11S47 \( K \)-theory of local fields [See also 19Fxx]

11S50 Other analytic theory (analogues of beta and gamma functions, \( p \)-adic integration, etc.)

11S52 Non-Archimedean dynamical systems [See mainly 37Pxx]

11S80 Other nonanalytic theory

11S90 Prehomogeneous vector spaces

11S99 None of the above, but in this section

11Txx Finite fields and commutative rings (number-theoretic aspects)

11T06 Polynomials over finite fields

11T22 Cyclotomy

11T23 Exponential sums

11T24 Other character sums and Gauss sums

11T30 Structure theory for finite fields and commutative rings, number-theoretic aspects

11T35 Arithmetic theory of polynomial rings over finite fields

11T60 Finite upper half-planes

11T70 Algebraic coding theory; cryptography (number-theoretic aspects)

11T99 None of the above, but in this section

11Uxx Connections of number theory and logic

11U05 Decidability (number-theoretic aspects) [See also 03B25]

11U07 Ultraproducts (number-theoretic aspects) [See also 03C20]

11U09 Model theory (number-theoretic aspects) [See also 03Cxx]

11U10 Nonstandard arithmetic (number-theoretic aspects) [See also 03H15]

11U99 None of the above, but in this section
11Yxx Computational number theory {For software etc., see 11-04}
11Y05 Factorization
11Y11 Primality
11Y16 Number-theoretic algorithms; complexity [See also 68Q25]
11Y35 Analytic computations
11Y40 Algebraic number theory computations
11Y50 Computer solution of Diophantine equations
11Y55 Calculation of integer sequences
11Y60 Evaluation of number-theoretic constants
11Y65 Continued fraction calculations (number-theoretic aspects)
11Y70 Values of arithmetic functions; tables
11Y99 None of the above, but in this section

11Zxx Miscellaneous applications of number theory
11Z05 Miscellaneous applications of number theory
11Z99 None of the above, but in this section

12-XX Field theory and polynomials
12-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to field theory
12-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to field theory
12-02 Research exposition (monographs, survey articles) pertaining to field theory
12-03 History of field theory [Consider also classification numbers pertaining to Section 01]
12-04 Software, source code, etc. for problems pertaining to field theory
12-06 Proceedings, conferences, collections, etc. pertaining to field theory
12-08 Computational methods for problems pertaining to field theory
12-11 Research data for problems pertaining to field theory

12Dxx Real and complex fields
12D05 Polynomials in real and complex fields: factorization
12D10 Polynomials in real and complex fields: location of zeros (algebraic theorems) {For the analytic theory, see 26C10, 30C15}
12D15 Fields related with sums of squares (formally real fields, Pythagorean fields, etc.) [See also 11Exx]
12D99 None of the above, but in this section
12Exx General field theory
12E05 Polynomials in general fields (irreducibility, etc.)
12E10 Special polynomials in general fields
12E12 Equations in general fields
12E15 Skew fields, division rings [See also 11R52, 11R54, 11S45, 16Kxx]
12E20 Finite fields (field-theoretic aspects)
12E25 Hilbertian fields; Hilbert’s irreducibility theorem
12E30 Field arithmetic
12E99 None of the above, but in this section

12Fxx Field extensions
12F05 Algebraic field extensions
12F10 Separable extensions, Galois theory
12F12 Inverse Galois theory
12F15 Inseparable field extensions
12F20 Transcendental field extensions
12F99 None of the above, but in this section

12Gxx Homological methods (field theory)
12G05 Galois cohomology [See also 14F22, 16Hxx, 16K50]
12G10 Cohomological dimension of fields
12G99 None of the above, but in this section

12Hxx Differential and difference algebra
12H05 Differential algebra [See also 13Nxx]
12H10 Difference algebra [See also 39Axx]
12H20 Abstract differential equations [See also 34Mxx]
12H25 p-adic differential equations [See also 11S80, 14G20]
12H99 None of the above, but in this section
12Jxx Topological fields
12J05 Normed fields
12J10 Valued fields
12J12 Formally p-adic fields
12J15 Ordered fields
12J17 Topological semifields
12J20 General valuation theory for fields [See also 13A18]
12J25 Non-Archimedean valued fields [See also 30G06, 32P05, 46S10, 47S10]
12J27 Krasner-Tate algebras [See mainly 32P05; see also 46S10, 47S10]
12J99 None of the above, but in this section

12Kxx Generalizations of fields
12K05 Near-fields [See also 16Y30]
12K10 Semifields [See also 16Y60]
12K99 None of the above, but in this section

12Lxx Connections between field theory and logic
12L05 Decidability and field theory [See also 03B25]
12L10 Ultraproducts and field theory [See also 03C20]
12L12 Model theory of fields [See also 03C60]
12L15 Nonstandard arithmetic and field theory [See also 03H15]
12L99 None of the above, but in this section

13-XX Commutative algebra
13-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to commutative algebra
13-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to commutative algebra
13-02 Research exposition (monographs, survey articles) pertaining to commutative algebra
13-03 History of commutative algebra [Consider also classification numbers pertaining to Section 01]
13-04 Software, source code, etc. for problems pertaining to commutative algebra
13-06 Proceedings, conferences, collections, etc. pertaining to commutative algebra
13-11 Research data for problems pertaining to commutative algebra
### 13Axx General commutative ring theory

**13A02** Graded rings [See also 16W50]

**13A05** Divisibility and factorizations in commutative rings [See also 13F15]

**13A15** Ideals and multiplicative ideal theory in commutative rings

**13A18** Valuations and their generalizations for commutative rings [See also 12J20]

**13A30** Associated graded rings of ideals (Rees ring, form ring), analytic spread and related topics

**13A35** Characteristic $p$ methods (Frobenius endomorphism) and reduction to characteristic $p$; tight closure [See also 13B22]

**13A50** Actions of groups on commutative rings; invariant theory [See also 14L24]

**13A70** General commutative ring theory and combinatorics (zero-divisor graphs, annihilating-ideal graphs, etc.) [See also 05C25, 05E40]

**13A99** None of the above, but in this section

### 13Bxx Commutative ring extensions and related topics

**13B02** Extension theory of commutative rings

**13B05** Galois theory and commutative ring extensions

**13B10** Morphisms of commutative rings

**13B21** Integral dependence in commutative rings; going up, going down

**13B22** Integral closure of commutative rings and ideals [See also 13A35]; integrally closed rings, related rings (Japanese, etc.)

**13B25** Polynomials over commutative rings [See also 11C08, 11T06, 13F20, 13M10]

**13B30** Rings of fractions and localization for commutative rings [See also 16S85]

**13B35** Completion of commutative rings [See also 13J10]

**13B40** Étale and flat extensions; Henselization; Artin approximation [See also 13J15, 14B12, 14B25]

**13B99** None of the above, but in this section

### 13Cxx Theory of modules and ideals in commutative rings

**13C05** Structure, classification theorems for modules and ideals in commutative rings

**13C10** Projective and free modules and ideals in commutative rings [See also 19A13]

**13C11** Injective and flat modules and ideals in commutative rings

**13C12** Torsion modules and ideals in commutative rings

**13C13** Other special types of modules and ideals in commutative rings

**13C14** Cohen-Macaulay modules [See also 13H10]

**13C15** Dimension theory, depth, related commutative rings (catenary, etc.)

**13C20** Class groups [See also 11R29]

**13C40** Linkage, complete intersections and determinantal ideals [See also 14M06, 14M10, 14M12]
| 13C60 | Module categories and commutative rings |
| 13C70 | Theory of modules and ideals in commutative rings described by combinatorial properties [See also 05C25, 05E40] |
| 13C99 | None of the above, but in this section |

**13Dxx Homological methods in commutative ring theory {For noncommutative rings, see 16Exx; for general categories, see 18Gxx}**

| 13D02 | Syzygies, resolutions, complexes and commutative rings |
| 13D03 | (Co)homology of commutative rings and algebras (e.g., Hochschild, André-Quillen, cyclic, dihedral, etc.) |
| 13D05 | Homological dimension and commutative rings |
| 13D07 | Homological functors on modules of commutative rings (Tor, Ext, etc.) |
| 13D09 | Derived categories and commutative rings |
| 13D10 | Deformations and infinitesimal methods in commutative ring theory [See also 14B10, 14B12, 14D15, 32Gxx] |
| 13D15 | Grothendieck groups, K-theory and commutative rings [See also 14C35, 18F30, 19Axx, 19D50] |
| 13D22 | Homological conjectures (intersection theorems) in commutative ring theory |
| 13D30 | Torsion theory for commutative rings [See also 13C12, 18E40] |
| 13D40 | Hilbert-Samuel and Hilbert-Kunz functions; Poincaré series |
| 13D45 | Local cohomology and commutative rings [See also 14B15] |
| 13D99 | None of the above, but in this section |

**13Exx Chain conditions, finiteness conditions in commutative ring theory**

| 13E05 | Commutative Noetherian rings and modules |
| 13E10 | Commutative Artinian rings and modules, finite-dimensional algebras |
| 13E15 | Commutative rings and modules of finite generation or presentation; number of generators |
| 13E99 | None of the above, but in this section |

**13Fxx Arithmetic rings and other special commutative rings**

| 13F05 | Dedekind, Prüfer, Krull and Mori rings and their generalizations |
| 13F07 | Euclidean rings and generalizations |
| 13F10 | Principal ideal rings |
| 13F15 | Commutative rings defined by factorization properties (e.g., atomic, factorial, half-factorial) [See also 13A05, 14M05] |
| 13F20 | Polynomial rings and ideals; rings of integer-valued polynomials [See also 11C08, 13B25] |
| 13F25 | Formal power series rings [See also 13J05] |
| 13F30 | Valuation rings [See also 13A18] |
| 13F35 | Witt vectors and related rings |
13F40 Excellent rings
13F45 Seminormal rings
13F50 Rings with straightening laws, Hodge algebras
13F55 Commutative rings defined by monomial ideals; Stanley-Reisner face rings; simplicial complexes [See also 55U10]
13F60 Cluster algebras
13F65 Commutative rings defined by binomial ideals, toric rings, etc. [See also 14M25]
13F70 Other commutative rings defined by combinatorial properties
13F99 None of the above, but in this section

13Gxx Integral domains
13G05 Integral domains
13G99 None of the above, but in this section

13Hxx Local rings and semilocal rings
13H05 Regular local rings
13H10 Special types (Cohen-Macaulay, Gorenstein, Buchsbaum, etc.) [See also 14M05]
13H15 Multiplicity theory and related topics [See also 14C17]
13H99 None of the above, but in this section

13Jxx Topological rings and modules [See also 16W60, 16W80]
13J05 Power series rings [See also 13F25]
13J07 Analytical algebras and rings [See also 32B05]
13J10 Complete rings, completion [See also 13B35]
13J15 Henselian rings [See also 13B40]
13J20 Global topological rings
13J25 Ordered rings [See also 06F25]
13J30 Real algebra [See also 12D15, 14Pxx]
13J99 None of the above, but in this section

13Lxx Applications of logic to commutative algebra [See also 03Cxx, 03Hxx]
13L05 Applications of logic to commutative algebra [See also 03Cxx, 03Hxx]
13L99 None of the above, but in this section

13Mxx Finite commutative rings {For number-theoretic aspects, see 11Txx}
13M05 Structure of finite commutative rings
13M10 Polynomials and finite commutative rings
13M99 None of the above, but in this section
13Nxx Differential algebra [See also 12H05, 14F10]

13N05 Modules of differentials

13N10 Commutative rings of differential operators and their modules [See also 16S32, 32C38]

13N15 Derivations and commutative rings

13N99 None of the above, but in this section

13Pxx Computational aspects and applications of commutative rings [See also 14Qxx, 68W30] {For software etc., see 13-04}

13P05 Polynomials, factorization in commutative rings [See also 12-08]

13P10 Gröbner bases; other bases for ideals and modules (e.g., Janet and border bases)

13P15 Solving polynomial systems; resultants

13P20 Computational homological algebra [See also 13Dxx]

13P25 Applications of commutative algebra (e.g., to statistics, control theory, optimization, etc.)

13P99 None of the above, but in this section

14-XX Algebraic geometry

14-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to algebraic geometry

14-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to algebraic geometry

14-02 Research exposition (monographs, survey articles) pertaining to algebraic geometry

14-03 History of algebraic geometry [Consider also classification numbers pertaining to Section 01]

14-04 Software, source code, etc. for problems pertaining to algebraic geometry

14-06 Proceedings, conferences, collections, etc. pertaining to algebraic geometry

14-11 Research data for problems pertaining to algebraic geometry

14Axx Foundations of algebraic geometry

14A05 Relevant commutative algebra [See also 13-XX]

14A10 Varieties and morphisms

14A15 Schemes and morphisms

14A20 Generalizations (algebraic spaces, stacks)

14A21 Logarithmic algebraic geometry, log schemes

14A22 Noncommutative algebraic geometry [See also 16S38]

14A23 Geometry over the field with one element

14A25 Elementary questions in algebraic geometry

14A30 Fundamental constructions in algebraic geometry involving higher and derived categories (homotopical algebraic geometry, derived algebraic geometry, etc.) {For categorical aspects, see 18Fxx, 18Gxx}

14A99 None of the above, but in this section
14Bxx Local theory in algebraic geometry

14B05 Singularities in algebraic geometry [See also 14E15, 14H20, 14J17, 32Sxx, 58Kxx]
14B07 Deformations of singularities [See also 14D15, 32S30]
14B10 Infinitesimal methods in algebraic geometry [See also 13D10]
14B12 Local deformation theory, Artin approximation, etc. [See also 13B40, 13D10]
14B15 Local cohomology and algebraic geometry [See also 13D45, 32C36]
14B20 Formal neighborhoods in algebraic geometry
14B25 Local structure of morphisms in algebraic geometry: étale, flat, etc. [See also 13B40]
14B99 None of the above, but in this section

14Cxx Cycles and subschemes

14C05 Parametrization (Chow and Hilbert schemes)
14C15 (Equivariant) Chow groups and rings; motives
14C17 Intersection theory, characteristic classes, intersection multiplicities in algebraic geometry [See also 13H15]
14C20 Divisors, linear systems, invertible sheaves
14C21 Pencils, nets, webs in algebraic geometry [See also 53A60]
14C22 Picard groups
14C25 Algebraic cycles
14C30 Transcendental methods, Hodge theory (algebrao-geometric aspects) [See also 14D07, 32G20, 32J25, 32S35],
Hodge conjecture
14C34 Torelli problem [See also 32G20]
14C35 Applications of methods of algebraic $K$-theory in algebraic geometry [See also 19Exx]
14C40 Riemann-Roch theorems [See also 19E20, 19L10]
14C99 None of the above, but in this section

14Dxx Families, fibrations in algebraic geometry

14D05 Structure of families (Picard-Lefschetz, monodromy, etc.)
14D06 Fibrations, degenerations in algebraic geometry
14D07 Variation of Hodge structures (algebrao-geometric aspects) [See also 32G20]
14D10 Arithmetic ground fields (finite, local, global) and families or fibrations
14D15 Formal methods and deformations in algebraic geometry [See also 13D10, 14B07, 32Gxx]
14D20 Algebraic moduli problems, moduli of vector bundles {For analytic moduli problems, see 32G13}
14D21 Applications of vector bundles and moduli spaces in mathematical physics (twistor theory, instantons, quantum field theory) [See also 32L25, 81Txx]
14D22 Fine and coarse moduli spaces
14D23 Stacks and moduli problems
14D24 Geometric Langlands program (algebrao-geometric aspects) [See also 22E57]
14D99 None of the above, but in this section
<table>
<thead>
<tr>
<th>14Exx</th>
<th>Birational geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>14E05</td>
<td>Rational and birational maps</td>
</tr>
<tr>
<td>14E07</td>
<td>Birational automorphisms, Cremona group and generalizations</td>
</tr>
<tr>
<td>14E08</td>
<td>Rationality questions in algebraic geometry [See also 14M20]</td>
</tr>
<tr>
<td>14E15</td>
<td>Global theory and resolution of singularities (algebro-geometric aspects) [See also 14B05, 32S20, 32S45]</td>
</tr>
<tr>
<td>14E16</td>
<td>McKay correspondence</td>
</tr>
<tr>
<td>14E18</td>
<td>Arcs and motivic integration</td>
</tr>
<tr>
<td>14E20</td>
<td>Coverings in algebraic geometry [See also 14H30]</td>
</tr>
<tr>
<td>14E22</td>
<td>Ramification problems in algebraic geometry [See also 11S15]</td>
</tr>
<tr>
<td>14E25</td>
<td>Embeddings in algebraic geometry</td>
</tr>
<tr>
<td>14E30</td>
<td>Minimal model program (Mori theory, extremal rays)</td>
</tr>
<tr>
<td>14E99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14Fxx</th>
<th>(Co)homology theory in algebraic geometry [See also 13Dxx]</th>
</tr>
</thead>
<tbody>
<tr>
<td>14F06</td>
<td>Sheaves in algebraic geometry [See also 14F07, 14H60, 14J60, 18F20, 32Lxx, 46M20]</td>
</tr>
<tr>
<td>14F07</td>
<td>Derived categories of sheaves, dg categories, and related constructions in algebraic geometry [See also 14A30, 14F06, 18Gxx]</td>
</tr>
<tr>
<td>14F10</td>
<td>Differentials and other special sheaves; D-modules; Bernstein-Sato ideals and polynomials [See also 13Nxx, 32C38]</td>
</tr>
<tr>
<td>14F17</td>
<td>Vanishing theorems in algebraic geometry [See also 32L20]</td>
</tr>
<tr>
<td>14F18</td>
<td>Multiplier ideals</td>
</tr>
<tr>
<td>14F20</td>
<td>Étale and other Grothendieck topologies and (co)homologies</td>
</tr>
<tr>
<td>14F22</td>
<td>Brauer groups of schemes [See also 12G05, 16K50]</td>
</tr>
<tr>
<td>14F25</td>
<td>Classical real and complex (co)homology in algebraic geometry</td>
</tr>
<tr>
<td>14F30</td>
<td>$p$-adic cohomology, crystalline cohomology</td>
</tr>
<tr>
<td>14F35</td>
<td>Homotopy theory and fundamental groups in algebraic geometry [See also 14H30]</td>
</tr>
<tr>
<td>14F40</td>
<td>de Rham cohomology and algebraic geometry [See also 14C30, 32C35, 32L10]</td>
</tr>
<tr>
<td>14F42</td>
<td>Motivic cohomology; motivic homotopy theory [See also 19E15]</td>
</tr>
<tr>
<td>14F43</td>
<td>Other algebro-geometric (co)homologies (e.g., intersection, equivariant, Lawson, Deligne (co)homologies)</td>
</tr>
<tr>
<td>14F45</td>
<td>Topological properties in algebraic geometry</td>
</tr>
<tr>
<td>14F99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
14Gxx Arithmetic problems in algebraic geometry; Diophantine geometry [See also 11Dxx, 11Gxx]

14G05 Rational points

14G10 Zeta functions and related questions in algebraic geometry (e.g., Birch-Swinnerton-Dyer conjecture) [See also 11G40]

14G12 Hasse principle, weak and strong approximation, Brauer-Manin obstruction [See also 14F22]

14G15 Finite ground fields in algebraic geometry

14G17 Positive characteristic ground fields in algebraic geometry

14G20 Local ground fields in algebraic geometry

14G22 Rigid analytic geometry

14G25 Global ground fields in algebraic geometry

14G27 Other nonalgebraically closed ground fields in algebraic geometry

14G32 Universal profinite groups (relationship to moduli spaces, projective and moduli towers, Galois theory)

14G35 Modular and Shimura varieties [See also 11F41, 11F46, 11G18]

14G40 Arithmetic varieties and schemes; Arakelov theory; heights [See also 11G50, 37P30]

14G45 Perfectoid spaces and mixed characteristic

14G50 Applications to coding theory and cryptography of arithmetic geometry [See also 94A60, 94B27, 94B40]

14G99 None of the above, but in this section

14Hxx Curves in algebraic geometry

14H05 Algebraic functions and function fields in algebraic geometry [See also 11R58]

14H10 Families, moduli of curves (algebraic)

14H15 Families, moduli of curves (analytic) [See also 30F10, 32G15]

14H20 Singularities of curves, local rings [See also 13Hxx, 14B05]

14H25 Arithmetic ground fields for curves [See also 11Dxx, 11G05, 14Gxx]

14H30 Coverings of curves, fundamental group [See also 14E20, 14F35]

14H37 Automorphisms of curves

14H40 Jacobians, Prym varieties [See also 32G20]

14H42 Theta functions and curves; Schottky problem [See also 14K25, 32G20]

14H45 Special algebraic curves and curves of low genus

14H50 Plane and space curves

14H51 Special divisors on curves (gonality, Brill-Noether theory)

14H52 Elliptic curves [See also 11G05, 11G07, 14Kxx]

14H55 Riemann surfaces; Weierstrass points; gap sequences [See also 30Fxx]
14H57 Dessins d’enfants theory {For arithmetic aspects, see 11G32}
14H60 Vector bundles on curves and their moduli [See also 14D20, 14F06, 14J60]
14H70 Relationships between algebraic curves and integrable systems
14H81 Relationships between algebraic curves and physics
14H99 None of the above, but in this section

14Jxx Surfaces and higher-dimensional varieties {For analytic theory, see 32Jxx}
14J10 Families, moduli, classification: algebraic theory
14J15 Moduli, classification: analytic theory; relations with modular forms [See also 32G13]
14J17 Singularities of surfaces or higher-dimensional varieties [See also 14B05, 14E15, 32S05, 32S25]
14J20 Arithmetic ground fields for surfaces or higher-dimensional varieties [See also 11Dxx, 11G25, 11G35, 14Gxx]
14J25 Special surfaces {For Hilbert modular surfaces, see 14G35}
14J26 Rational and ruled surfaces
14J27 Elliptic surfaces, elliptic or Calabi-Yau fibrations
14J28 K3 surfaces and Enriques surfaces
14J29 Surfaces of general type
14J30 3-folds
14J32 Calabi-Yau manifolds (algebro-geometric aspects) [See also 32Q25]
14J33 Mirror symmetry (algebro-geometric aspects) [See also 11G42, 53D37]
14J35 4-folds
14J40 n-folds (n > 4)
14J42 Holomorphic symplectic varieties, hyper-Kähler varieties
14J45 Fano varieties
14J50 Automorphisms of surfaces and higher-dimensional varieties
14J60 Vector bundles on surfaces and higher-dimensional varieties, and their moduli [See also 14D20, 14F06, 14H60, 32Lxx]
14J70 Hypersurfaces and algebraic geometry
14J80 Topology of surfaces (Donaldson polynomials, Seiberg-Witten invariants)
14J81 Relationships with physics
14J99 None of the above, but in this section
14Kxx Abelian varieties and schemes
14K02 Isogeny
14K05 Algebraic theory of abelian varieties
14K10 Algebraic moduli of abelian varieties, classification [See also 11G15]
14K12 Subvarieties of abelian varieties
14K15 Arithmetic ground fields for abelian varieties [See also 11Dxx, 11Fxx, 11G10, 14Gxx]
14K20 Analytic theory of abelian varieties; abelian integrals and differentials
14K22 Complex multiplication and abelian varieties [See also 11G15]
14K25 Theta functions and abelian varieties [See also 14H42]
14K30 Picard schemes, higher Jacobians [See also 14H40, 32G20]
14K99 None of the above, but in this section

14Lxx Algebraic groups {For linear algebraic groups, see 20Gxx; for Lie algebras, see 17B45}
14L05 Formal groups, $p$-divisible groups [See also 55N22]
14L10 Group varieties
14L15 Group schemes
14L17 Affine algebraic groups, hyperalgebra constructions [See also 17B45, 18C40]
14L24 Geometric invariant theory [See also 13A50]
14L30 Group actions on varieties or schemes (quotients) [See also 13A50, 14L24, 14M17]
14L35 Classical groups (algebro-geometric aspects) [See also 20Gxx, 51N30]
14L40 Other algebraic groups (geometric aspects)
14L99 None of the above, but in this section

14Mxx Special varieties
14M05 Varieties defined by ring conditions (factorial, Cohen-Macaulay, seminormal) [See also 13F15, 13F45, 13H10]
14M06 Linkage [See also 13C40]
14M07 Low codimension problems in algebraic geometry
14M10 Complete intersections [See also 13C40]
14M12 Determinantal varieties [See also 13C40]
14M15 Grassmannians, Schubert varieties, flag manifolds [See also 32M10, 51M35]
14M17 Homogeneous spaces and generalizations [See also 32M10, 53C30, 57T15]
14M20 Rational and unirational varieties [See also 14E08]
14M22 Rationally connected varieties
14M25 Toric varieties, Newton polyhedra, Okounkov bodies [See also 52B20]
14M27 Compactifications; symmetric and spherical varieties
14M30 Supervarieties [See also 32C11, 58A50]
14M35 Character varieties
14M99 None of the above, but in this section

14Nxx Projective and enumerative algebraic geometry [See also 51-XX]
14N05 Projective techniques in algebraic geometry [See also 51N35]
14N07 Secant varieties, tensor rank, varieties of sums of powers
14N10 Enumerative problems (combinatorial problems) in algebraic geometry
14N15 Classical problems, Schubert calculus
14N20 Configurations and arrangements of linear subspaces
14N25 Varieties of low degree
14N30 Adjunction problems
14N35 Gromov-Witten invariants, quantum cohomology, Gopakumar-Vafa invariants, Donaldson-Thomas invariants (algebro-geometric aspects) [See also 53D45]
14N99 None of the above, but in this section

14Pxx Real algebraic and real-analytic geometry
14P05 Real algebraic sets [See also 12D15, 13J30]
14P10 Semialgebraic sets and related spaces
14P15 Real-analytic and semi-analytic sets [See also 32B20, 32C05]
14P20 Nash functions and manifolds [See also 32C07, 58A07]
14P25 Topology of real algebraic varieties
14P99 None of the above, but in this section

14Qxx Computational aspects in algebraic geometry {For software etc., see 14-04} [See also 12-08, 13Pxx, 68W30]
14Q05 Computational aspects of algebraic curves [See also 14Hxx]
14Q10 Computational aspects of algebraic surfaces [See also 14Jxx]
14Q15 Computational aspects of higher-dimensional varieties [See also 14Jxx, 14Mxx]
14Q20 Effectivity, complexity and computational aspects of algebraic geometry
14Q25 Computational algebraic geometry over arithmetic ground fields [See also 14Gxx, 14H25, 14Kxx]
14Q30 Computational real algebraic geometry [See also 14Pxx]
14Q65 Geometric aspects of numerical algebraic geometry [See also 65H14]
14Q99 None of the above, but in this section
14Rxx Affine geometry
14R05 Classification of affine varieties
14R10 Affine spaces (automorphisms, embeddings, exotic structures, cancellation problem)
14R15 Jacobian problem [See also 13F20]
14R20 Group actions on affine varieties [See also 13A50, 14L30]
14R25 Affine fibrations [See also 14D06]
14R99 None of the above, but in this section

14Txx Tropical geometry [See also 12K10, 14M25, 14N10, 52B20]
14T10 Foundations of tropical geometry and relations with algebra {For algebraic aspects, see 15A80}
14T15 Combinatorial aspects of tropical varieties
14T20 Geometric aspects of tropical varieties
14T25 Arithmetic aspects of tropical varieties
14T90 Applications of tropical geometry
14T99 None of the above, but in this section

15-XX Linear and multilinear algebra; matrix theory
15-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to linear algebra
15-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to linear algebra
15-02 Research exposition (monographs, survey articles) pertaining to linear algebra
15-03 History of linear algebra [Consider also classification numbers pertaining to Section 01]
15-04 Software, source code, etc. for problems pertaining to linear algebra
15-06 Proceedings, conferences, collections, etc. pertaining to linear algebra
15-11 Research data for problems pertaining to linear algebra

15Axx Basic linear algebra
15A03 Vector spaces, linear dependence, rank, lineability
15A04 Linear transformations, semilinear transformations
15A06 Linear equations (linear algebraic aspects)
15A09 Theory of matrix inversion and generalized inverses
15A10 Applications of generalized inverses
15A12 Conditioning of matrices [See also 65F35]
15A15 Determinants, permanents, traces, other special matrix functions [See also 19B10, 19B14]
15A16 Matrix exponential and similar functions of matrices
15A18 Eigenvalues, singular values, and eigenvectors
15A20 Diagonalization, Jordan forms
15A21 Canonical forms, reductions, classification
15A22 Matrix pencils [See also 47A56]
15A23 Factorization of matrices
15A24 Matrix equations and identities
15A27 Commutativity of matrices
15A29 Inverse problems in linear algebra
15A30 Algebraic systems of matrices [See also 16S50, 20Gxx, 20Hxx]
15A39 Linear inequalities of matrices
15A42 Inequalities involving eigenvalues and eigenvectors
15A45 Miscellaneous inequalities involving matrices
15A54 Matrices over function rings in one or more variables
15A60 Norms of matrices, numerical range, applications of functional analysis to matrix theory [See also 65F35, 65J05]
15A63 Quadratic and bilinear forms, inner products [See mainly 11Exx]
15A66 Clifford algebras, spinors
15A67 Applications of Clifford algebras to physics, etc.
15A69 Multilinear algebra, tensor calculus
15A72 Vector and tensor algebra, theory of invariants [See also 13A50, 14L24]
15A75 Exterior algebra, Grassmann algebras
15A78 Other algebras built from modules
15A80 Max-plus and related algebras
15A83 Matrix completion problems
15A86 Linear preserver problems
15A99 None of the above, but in this section

15Bxx Special matrices
15B05 Toeplitz, Cauchy, and related matrices
15B10 Orthogonal matrices
15B15 Fuzzy matrices
15B30 Matrix Lie algebras
15B33 Matrices over special rings (quaternions, finite fields, etc.)
15B34 Boolean and Hadamard matrices
15B35 Sign pattern matrices
15B36 Matrices of integers [See also 11C20]
15B48 Positive matrices and their generalizations; cones of matrices
15B51 Stochastic matrices
15B52 Random matrices (algebraic aspects) {For probabilistic aspects, see 60B20}
15B57 Hermitian, skew-Hermitian, and related matrices
15B99 None of the above, but in this section

16-XX Associative rings and algebras {For the commutative case, see 13-XX}

16-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to associative rings and algebras
16-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to associative rings and algebras
16-02 Research exposition (monographs, survey articles) pertaining to associative rings and algebras
16-03 History of associative rings and algebras [Consider also classification numbers pertaining to Section 01]
16-04 Software, source code, etc. for problems pertaining to associative rings and algebras
16-06 Proceedings, conferences, collections, etc. pertaining to associative rings and algebras
16-11 Research data for problems pertaining to associative rings and algebras

16Bxx General and miscellaneous
16B50 Category-theoretic methods and results in associative algebras (except as in 16D90) [See also 18-XX]
16B70 Applications of logic in associative algebras [See also 03Cxx]
16B99 None of the above, but in this section

16Dxx Modules, bimodules and ideals in associative algebras
16D10 General module theory in associative algebras
16D20 Bimodules in associative algebras
16D25 Ideals in associative algebras
16D30 Infinite-dimensional simple rings (except as in 16Kxx)
16D40 Free, projective, and flat modules and ideals in associative algebras [See also 19A13]
16D50 Injective modules, self-injective associative rings [See also 16L60]
16D60 Simple and semisimple modules, primitive rings and ideals in associative algebras
16D70 Structure and classification for modules, bimodules and ideals (except as in 16Gxx), direct sum decomposition and cancellation in associative algebras
16D80 Other classes of modules and ideals in associative algebras [See also 16G50]
16D90 Module categories in associative algebras [See also 16Gxx, 16S90]; module theory in a category-theoretic context; Morita equivalence and duality
16D99 None of the above, but in this section
16Exx Homological methods in associative algebras {For commutative rings, see 13Dxx; for general categories, see 18Gxx}

16E05 Syzygies, resolutions, complexes in associative algebras
16E10 Homological dimension in associative algebras
16E20 Grothendieck groups, K-theory, etc. [See also 18F30, 19Axx, 19D50]
16E30 Homological functors on modules (Tor, Ext, etc.) in associative algebras
16E35 Derived categories and associative algebras
16E40 (Co)homology of rings and associative algebras (e.g., Hochschild, cyclic, dihedral, etc.)
16E45 Differential graded algebras and applications (associative algebraic aspects)
16E50 von Neumann regular rings and generalizations (associative algebraic aspects)
16E60 Semihereditary and hereditary rings, free ideal rings, Sylvester rings, etc.
16E65 Homological conditions on associative rings (generalizations of regular, Gorenstein, Cohen-Macaulay rings, etc.)
16E99 None of the above, but in this section

16Gxx Representation theory of associative rings and algebras

16G10 Representations of associative Artinian rings
16G20 Representations of quivers and partially ordered sets
16G30 Representations of orders, lattices, algebras over commutative rings [See also 16Hxx]
16G50 Cohen-Macaulay modules in associative algebras
16G60 Representation type (finite, tame, wild, etc.) of associative algebras
16G70 Auslander-Reiten sequences (almost split sequences) and Auslander-Reiten quivers
16G99 None of the above, but in this section

16Hxx Associative algebras and orders {For arithmetic aspects, see 11R52, 11R54, 11S45; for representation theory, see 16G30}

16H05 Separable algebras (e.g., quaternion algebras, Azumaya algebras, etc.)
16H10 Orders in separable algebras
16H15 Commutative orders
16H20 Lattices over orders
16H99 None of the above, but in this section

16Kxx Division rings and semisimple Artin rings [See also 12E15, 15A30]

16K20 Finite-dimensional division rings {For crossed products, see 16S35}
16K40 Infinite-dimensional and general division rings
16K50 Brauer groups (algebraic aspects) [See also 12G05, 14F22]
16K99 None of the above, but in this section
16Lxx Local rings and generalizations
16L30 Noncommutative local and semilocal rings, perfect rings
16L60 Quasi-Frobenius rings [See also 16D50]
16L99 None of the above, but in this section

16Nxx Radicals and radical properties of associative rings
16N20 Jacobson radical, quasimultiplication
16N40 Nil and nilpotent radicals, sets, ideals, associative rings
16N60 Prime and semiprime associative rings [See also 16D60, 16U10]
16N80 General radicals and associative rings {For radicals in module categories, see 16S90}
16N99 None of the above, but in this section

16Pxx Chain conditions, growth conditions, and other forms of finiteness for associative rings and algebras
16P10 Finite rings and finite-dimensional associative algebras {For semisimple, see 16K20; for commutative, see 11Txx, 13Mxx}
16P20 Artinian rings and modules (associative rings and algebras)
16P40 Noetherian rings and modules (associative rings and algebras)
16P50 Localization and associative Noetherian rings [See also 16U20]
16P60 Chain conditions on annihilators and summands: Goldie-type conditions [See also 16U20], Krull dimension (associative rings and algebras)
16P70 Chain conditions on other classes of submodules, ideals, subrings, etc.; coherence (associative rings and algebras)
16P90 Growth rate, Gelfand-Kirillov dimension
16P99 None of the above, but in this section

16Rxx Rings with polynomial identity
16R10 T-ideals, identities, varieties of associative rings and algebras
16R20 Semiprime p.i. rings, rings embeddable in matrices over commutative rings
16R30 Trace rings and invariant theory (associative rings and algebras)
16R40 Identities other than those of matrices over commutative rings
16R50 Other kinds of identities (generalized polynomial, rational, involution)
16R60 Functional identities (associative rings and algebras)
16R99 None of the above, but in this section
16Sxx Associative rings and algebras arising under various constructions

16S10 Associative rings determined by universal properties (free algebras, coproducts, adjunction of inverses, etc.)

16S15 Finite generation, finite presentability, normal forms (diamond lemma, term-rewriting)

16S20 Centralizing and normalizing extensions

16S30 Universal enveloping algebras of Lie algebras [See mainly 17B35]

16S32 Rings of differential operators (associative algebraic aspects) [See also 13N10, 32C38]

16S34 Group rings [See also 20C05, 20C07], Laurent polynomial rings (associative algebraic aspects)

16S35 Twisted and skew group rings, crossed products

16S36 Ordinary and skew polynomial rings and semigroup rings [See also 20M25]

16S37 Quadratic and Koszul algebras

16S38 Rings arising from noncommutative algebraic geometry [See also 14A22]

16S40 Smash products of general Hopf actions [See also 16T05]

16S50 Endomorphism rings; matrix rings [See also 15-XX]

16S60 Associative rings of functions, subdirect products, sheaves of rings

16S70 Extensions of associative rings by ideals

16S80 Deformations of associative rings [See also 13D10, 14D15]

16S85 Associative rings of fractions and localizations [See also 13B30]

16S88 Leavitt path algebras

16S90 Torsion theories; radicals on module categories (associative algebraic aspects) [See also 13D30, 18E40] {For radicals of rings, see 16Nxx}

16S99 None of the above, but in this section

16Txx Hopf algebras, quantum groups and related topics

16T05 Hopf algebras and their applications [See also 16S40, 57T05]

16T10 Bialgebras

16T15 Coalgebras and comodules; corings

16T20 Ring-theoretic aspects of quantum groups [See also 17B37, 20G42, 81R50]

16T25 Yang-Baxter equations

16T30 Connections of associative rings and algebras with combinatorics

16T99 None of the above, but in this section
16Uxx Conditions on elements
16U10 Integral domains (associative rings and algebras)
16U20 Ore rings, multiplicative sets, Ore localization
16U30 Divisibility, noncommutative UFDs
16U40 Idempotent elements
16U50 Generalized inverses
16U60 Units, groups of units (associative rings and algebras)
16U70 Center, normalizer (invariant elements) (associative rings and algebras)
16U80 Generalizations of commutativity (associative rings and algebras)
16U99 None of the above, but in this section

16Wxx Associative rings and algebras with additional structure
16W10 Rings with involution; Lie, Jordan and other nonassociative structures [See also 17B60, 17C50, 46Kxx]
16W20 Automorphisms and endomorphisms
16W22 Actions of groups and semigroups; invariant theory (associative rings and algebras)
16W25 Derivations, actions of Lie algebras
16W50 Graded rings and modules (associative rings and algebras)
16W55 “Super” (or “skew”) structure [See also 17A70, 17Bxx, 17C70] {For exterior algebras, see 15A75; for Clifford algebras, see 11E88, 15A66}
16W60 Valuations, completions, formal power series and related constructions (associative rings and algebras) [See also 13Jxx]
16W70 Filtered associative rings; filtrational and graded techniques
16W80 Topological and ordered rings and modules [See also 06F25, 13Jxx]
16W99 None of the above, but in this section

16Yxx Generalizations {For nonassociative rings, see 17-XX}
16Y20 Hyperrings
16Y30 Near-rings [See also 12K05]
16Y60 Semirings [See also 12K10]
16Y80 Γ and fuzzy structures
16Y99 None of the above, but in this section

16Zxx Computational aspects of associative rings {For software etc., see 16-04}
16Z05 Computational aspects of associative rings [See also 68W30]
16Z10 Gröbner-Shirshov bases
16Z99 None of the above, but in this section
17-XX Nonassociative rings and algebras

17-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to nonassociative rings and algebras

17-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to nonassociative rings and algebras

17-02 Research exposition (monographs, survey articles) pertaining to nonassociative rings and algebras

17-03 History of nonassociative rings and algebras [Consider also classification numbers pertaining to Section 01]

17-04 Software, source code, etc. for problems pertaining to nonassociative rings and algebras

17-06 Proceedings, conferences, collections, etc. pertaining to nonassociative rings and algebras

17-08 Computational methods for problems pertaining to nonassociative rings and algebras

17-11 Research data for problems pertaining to nonassociative rings and algebras

17Axx General nonassociative rings

17A01 General theory of nonassociative rings and algebras

17A05 Power-associative rings

17A15 Noncommutative Jordan algebras

17A20 Flexible algebras

17A30 Nonassociative algebras satisfying other identities

17A32 Leibniz algebras

17A35 Nonassociative division algebras

17A36 Automorphisms, derivations, other operators (nonassociative rings and algebras)

17A40 Ternary compositions

17A42 Other $n$-ary compositions ($n \geq 3$)

17A45 Quadratic algebras (but not quadratic Jordan algebras)

17A50 Free nonassociative algebras

17A60 Structure theory for nonassociative algebras

17A61 Gröbner-Shirshov bases in nonassociative algebras

17A65 Radical theory (nonassociative rings and algebras)

17A70 Superalgebras

17A75 Composition algebras

17A80 Valued algebras

17A99 None of the above, but in this section
17Bxx Lie algebras and Lie superalgebras {For Lie groups, see 22Exx}

17B01 Identities, free Lie (super)algebras
17B05 Structure theory for Lie algebras and superalgebras
17B08 Coadjoint orbits; nilpotent varieties
17B10 Representations of Lie algebras and Lie superalgebras, algebraic theory (weights)
17B15 Representations of Lie algebras and Lie superalgebras, analytic theory
17B20 Simple, semisimple, reductive (super)algebras
17B22 Root systems
17B25 Exceptional (super)algebras
17B30 Solvable, nilpotent (super)algebras
17B35 Universal enveloping (super)algebras [See also 16S30]
17B37 Quantum groups (quantized enveloping algebras) and related deformations [See also 16T20, 20G42, 81R50, 82B23]
17B38 Yang-Baxter equations and Rota-Baxter operators
17B40 Automorphisms, derivations, other operators for Lie algebras and super algebras
17B45 Lie algebras of linear algebraic groups [See also 14Lxx and 20Gxx]
17B50 Modular Lie (super)algebras
17B55 Homological methods in Lie (super)algebras
17B56 Cohomology of Lie (super)algebras
17B60 Lie (super)algebras associated with other structures (associative, Jordan, etc.) [See also 16W10, 17C40, 17C50]
17B61 Hom-Lie and related algebras
17B62 Lie bialgebras; Lie coalgebras
17B63 Poisson algebras
17B65 Infinite-dimensional Lie (super)algebras [See also 22E65]
17B66 Lie algebras of vector fields and related (super) algebras
17B67 Kac-Moody (super)algebras; extended affine Lie algebras; toroidal Lie algebras
17B68 Virasoro and related algebras
17B69 Vertex operators; vertex operator algebras and related structures
17B70 Graded Lie (super)algebras
17B75 Color Lie (super)algebras
17B80 Applications of Lie algebras and superalgebras to integrable systems
17B81 Applications of Lie (super)algebras to physics, etc.
17B99 None of the above, but in this section
17Cxx Jordan algebras (algebras, triples and pairs)
17C05 Identities and free Jordan structures
17C10 Structure theory for Jordan algebras
17C17 Radicals in Jordan algebras
17C20 Simple, semisimple Jordan algebras
17C27 Idempotents, Peirce decompositions
17C30 Associated groups, automorphisms of Jordan algebras
17C36 Associated manifolds of Jordan algebras
17C37 Associated geometries of Jordan algebras
17C40 Exceptional Jordan structures
17C50 Jordan structures associated with other structures [See also 16W10]
17C55 Finite-dimensional structures of Jordan algebras
17C60 Division algebras and Jordan algebras
17C65 Jordan structures on Banach spaces and algebras [See also 46H70, 46L70]
17C70 Super structures
17C90 Applications of Jordan algebras to physics, etc.
17C99 None of the above, but in this section

17Dxx Other nonassociative rings and algebras
17D05 Alternative rings
17D10 Mal’tsev rings and algebras
17D15 Right alternative rings
17D20 (γ, δ)-rings, including (1, −1)-rings
17D25 Lie-admissible algebras
17D30 (non-Lie) Hom algebras and topics
17D92 Genetic algebras
17D99 None of the above, but in this section

18-XX Category theory; homological algebra {For commutative rings, see 13Dxx; for associative rings, see 16Exx; for groups, see 20Jxx; for topological groups and related structures, see 57Txx; for algebraic topology, see also 55Nxx, 55Uxx}
18-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to category theory
18-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to category theory
18-02 Research exposition (monographs, survey articles) pertaining to category theory
18-03 History of category theory [Consider also classification numbers pertaining to Section 01]
18-04 Software, source code, etc. for problems pertaining to category theory
18-06 Proceedings, conferences, collections, etc. pertaining to category theory
18-08 Computational methods for problems pertaining to category theory
18-11 Research data for problems pertaining to category theory

18Axx General theory of categories and functors
18A05 Definitions and generalizations in theory of categories
18A10 Graphs, diagram schemes, precategories
18A15 Foundations, relations to logic and deductive systems [See also 03-XX]
18A20 Epimorphisms, monomorphisms, special classes of morphisms, null morphisms
18A22 Special properties of functors (faithful, full, etc.)
18A23 Natural morphisms, dinatural morphisms
18A25 Functor categories, comma categories
18A30 Limits and colimits (products, sums, directed limits, pushouts, fiber products, equalizers, kernels, ends and coends, etc.)
18A32 Factorization systems, substructures, quotient structures, congruences, amalgams
18A35 Categories admitting limits (complete categories), functors preserving limits, completions
18A40 Adjoint functors (universal constructions, reflective subcategories, Kan extensions, etc.)
18A50 Graded categories (general) {For dg categories, see 18G35}
18A99 None of the above, but in this section

18Bxx Special categories
18B05 Categories of sets, characterizations [See also 03-XX]
18B10 Categories of spans/cospans, relations, or partial maps
18B15 Embedding theorems, universal categories [See also 18E20]
18B20 Categories of machines, automata [See also 03D05, 68Qxx]
18B25 Topoi [See also 03G30, 18F10]
18B35 Preorders, orders, domains and lattices (viewed as categories) [See also 06-XX]
18B40 Groupoids, semigroupoids, semigroups, groups (viewed as categories) [See also 20Axx, 20L05, 20Mxx]
18B50 Extensive, distributive, and adhesive categories
18B99 None of the above, but in this section
18Cxx Categories and theories

18C05 Equational categories [See also 03C05, 08C05]

18C10 Theories (e.g., algebraic theories), structure, and semantics [See also 03G30]

18C15 Monads (= standard construction, monad or triad), algebras for a triple, homology and derived functors for triples [See also 18Gxx] {For functional programming, see also 68N18}

18C20 Eilenberg-Moore and Kleisli constructions for monads

18C30 Sketches and generalizations

18C35 Accessible and locally presentable categories

18C40 Structured objects in a category (group objects, etc.)

18C50 Categorical semantics of formal languages [See also 68Q55, 68Q65]

18C99 None of the above, but in this section

18Dxx Categorical structures

18D15 Closed categories (closed monoidal and Cartesian closed categories, etc.)

18D20 Enriched categories (over closed or monoidal categories)

18D25 Actions of a monoidal category, tensorial strength {For functional programming, see also 68N18}

18D30 Fibered categories

18D40 Internal categories and groupoids {For double categories, see 18N10; for topological groupoids, see 22A22; for Lie groupoids, see 58H05}

18D60 Profunctors (= correspondences, distributors, modules)

18D65 Proarrow equipments, Yoneda structures, KZ doctrines (lax idempotent monads)

18D70 Formal category theory

18D99 None of the above, but in this section

18Exx Categorical algebra

18E05 Preadditive, additive categories

18E08 Regular categories, Barr-exact categories

18E10 Abelian categories, Grothendieck categories

18E13 Protomodular categories, semi-abelian categories, Mal’tsev categories [See also 08B05 and 18B10]

18E20 Categorical embedding theorems [See also 18B15]

18E35 Localization of categories, calculus of fractions {For homotopical aspects, see also 18N45, 55P60}

18E40 Torsion theories, radicals [See also 13D30, 16S90]

18E45 Definable subcategories and connections with model theory [See also 13C60]

18E50 Categorical Galois theory

18E99 None of the above, but in this section
18Fxx Categories in geometry and topology
18F05 Local categories and functors
18F10 Grothendieck topologies and Grothendieck topoi [See also 14F20, 18B25]
18F15 Abstract manifolds and fiber bundles (category-theoretic aspects) [See also 55Rxx, 57Pxx]
18F20 Presheaves and sheaves, stacks, descent conditions (category-theoretic aspects) [See also 14F06, 14F07, 32C35, 32L10, 54B40, 55N30]
18F25 Algebraic K-theory and L-theory (category-theoretic aspects) [See also 11Exx, 11R70, 11S70, 12-XX, 13D15, 14Cxx, 16E20, 19-XX, 46L80, 57R65, 57R67]
18F30 Grothendieck groups (category-theoretic aspects) [See also 13D15, 16E20, 19Axx]
18F40 Synthetic differential geometry, tangent categories, differential categories
18F50 Goodwillie calculus and functor calculus
18F60 Categories of topological spaces and continuous mappings [See also 54-XX]
18F70 Frames and locales, pointfree topology, Stone duality [See also 06D22, 18B35]
18F75 Quantales [See also 06F07, 18B35]
18F99 None of the above, but in this section

18Gxx Homological algebra in category theory, derived categories and functors [See also 13Dxx, 16Exx, 20Jxx, 55Nxx, 55Uxx, 57Txx]
18G05 Projectives and injectives (category-theoretic aspects) [See also 13C10, 13C11, 16D40, 16D50]
18G10 Resolutions; derived functors (category-theoretic aspects) [See also 13D02, 16E05, 18Gxx]
18G15 Ext and Tor, generalizations, Künneth formula (category-theoretic aspects) [See also 55U25]
18G20 Homological dimension (category-theoretic aspects) [See also 13D05, 16E10]
18G25 Relative homological algebra, projective classes (category-theoretic aspects)
18G31 Simplicial modules and Dold-Kan correspondence
18G35 Chain complexes (category-theoretic aspects), dg categories [See also 14F07, 18G80, 55U15]
18G40 Spectral sequences, hypercohomology [See also 55Txx]
18G45 2-groups, crossed modules, crossed complexes
18G50 Nonabelian homological algebra (category-theoretic aspects)
18G65 Stable module categories [See also 20C20]
18G70 A_\infty-categories, relations with homological mirror symmetry [See also 14F07, 14J33, 53D37]
18G80 Derived categories, triangulated categories
18G85 Graph complexes and graph homology {For relations with deformation quantization, see 53D55}
18G90 Other (co)homology theories (category-theoretic aspects) [See also 19D55, 46L80, 58J20, 58J22]
18G99 None of the above, but in this section
18Mxx Monoidal categories and operads

18M05 Monoidal categories, symmetric monoidal categories [See also 19D23]
18M10 Traced monoidal categories, compact closed categories, star-autonomous categories
18M15 Braided monoidal categories and ribbon categories {For applications to knot theory, see also 57Kxx; for applications to quantum groups, see also 16T20, 17B37, 81R50}
18M20 Fusion categories, modular tensor categories, modular functors {For applications to topological quantum field theories, see also 57R56; for applications to conformal field theories, see also 81T40}
18M25 Tannakian categories {For applications to motives, see also 14C15, 19E15}
18M30 String diagrams and graphical calculi
18M35 Categories of networks and processes, compositionality
18M40 Dagger categories, categorical quantum mechanics [See also 81P68]
18M45 Categorical aspects of linear logic [See also 03B47]
18M50 Bimonoidal, skew-monoidal, duoidal categories
18M60 Operads (general)
18M65 Non-symmetric operads, multicategories, generalized multicategories
18M70 Algebraic operads, cooperads, and Koszul duality
18M75 Topological and simplicial operads [See also 18N60]
18M80 Species, Hopf monoids, operads in combinatorics
18M85 Polycategories/dioperads, properads, PROPs, cyclic operads, modular operads
18M90 Globular operads
18M99 None of the above, but in this section

18Nxx Higher categories and homotopical algebra

18N10 2-categories, bicategories, double categories
18N15 2-dimensional monad theory [See also 18C15]
18N20 Tricategories, weak n-categories, coherence, semi-strictification
18N25 Categorification
18N30 Strict omegacategories, computads, polygraphs
18N40 Homotopical algebra, Quillen model categories, derivators [See also 55U35]
18N45 Categories of fibrations, relations to K-theory, relations to type theory
18N50 Simplicial sets, simplicial objects [See also 55U10]
18N55 Localizations (e.g., simplicial localization, Bousfield localization) [See also 18E35, 55P60]
18N60 (\(\infty, 1\))-categories (quasi-categories, Segal spaces, etc.); \(\infty\)-topoi, stable \(\infty\)-categories [See also 55U35, 55U40]
18N65 (\(\infty, n\))-categories and (\(\infty, \infty\))-categories
18N70 \(\infty\)-operads and higher algebra [See also 18M75]
18N99 None of the above, but in this section
19-XX K-theory [See also 16E20, 18F25]

19-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to K-theory
19-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to K-theory
19-02 Research exposition (monographs, survey articles) pertaining to K-theory
19-03 History of K-theory [Consider also classification numbers pertaining to Section 01]
19-04 Software, source code, etc. for problems pertaining to K-theory
19-06 Proceedings, conferences, collections, etc. pertaining to K-theory
19-08 Computational methods for problems pertaining to K-theory
19-11 Research data for problems pertaining to K-theory

19Axx Grothendieck groups and $K_0$ [See also 13D15, 18F30]
19A13 Stability for projective modules [See also 13C10]
19A15 Efficient generation of modules
19A22 Frobenius induction, Burnside and representation rings
19A31 $K_0$ of group rings and orders
19A49 $K_0$ of other rings
19A99 None of the above, but in this section

19Bxx Whitehead groups and $K_1$
19B10 Stable range conditions
19B14 Stability for linear groups
19B28 $K_1$ of group rings and orders [See also 57Q10]
19B37 Congruence subgroup problems [See also 20H05]
19B99 None of the above, but in this section

19Cxx Steinberg groups and $K_2$
19C09 Central extensions and Schur multipliers
19C20 Symbols, presentations and stability of $K_2$
19C30 $K_2$ and the Brauer group
19C40 Excision for $K_2$
19C99 None of the above, but in this section
19Dxx Higher algebraic $K$-theory
19D06 $Q$- and plus-constructions
19D10 Algebraic $K$-theory of spaces
19D23 Symmetric monoidal categories [See also 18M05]
19D25 Karoubi-Villamayor-Gersten $K$-theory
19D35 Negative $K$-theory, NK and Nil
19D45 Higher symbols, Milnor $K$-theory
19D50 Computations of higher $K$-theory of rings [See also 13D15, 16E20]
19D55 $K$-theory and homology; cyclic homology and cohomology [See also 18G90]
19D99 None of the above, but in this section

19Exx $K$-theory in geometry
19E08 $K$-theory of schemes [See also 14C35]
19E15 Algebraic cycles and motivic cohomology ($K$-theoretic aspects) [See also 14C25, 14C35, 14F42]
19E20 Relations of $K$-theory with cohomology theories [See also 14Fxx]
19E99 None of the above, but in this section

19Fxx $K$-theory in number theory [See also 11R70, 11S70]
19F05 Generalized class field theory ($K$-theoretic aspects) [See also 11G45]
19F15 Symbols and arithmetic ($K$-theoretic aspects) [See also 11R37]
19F27 Étale cohomology, higher regulators, zeta and $L$-functions ($K$-theoretic aspects) [See also 11G40, 11R42, 11S40, 14F20, 14G10]
19F99 None of the above, but in this section

19Gxx $K$-theory of forms [See also 11Exx]
19G05 Stability for quadratic modules
19G12 Witt groups of rings [See also 11E81]
19G24 $L$-theory of group rings [See also 11E81]
19G38 Hermitian $K$-theory, relations with $K$-theory of rings
19G99 None of the above, but in this section

19Jxx Obstructions from topology
19J05 Finiteness and other obstructions in $K_0$
19J10 Whitehead (and related) torsion
19J25 Surgery obstructions ($K$-theoretic aspects) [See also 57R67]
19J35 Obstructions to group actions ($K$-theoretic aspects)
19J99 None of the above, but in this section
19Kxx $K$-theory and operator algebras [See mainly 46L80, and also 46M20]
19K14 $K_0$ as an ordered group, traces
19K33 Ext and $K$-homology [See also 55N22]
19K35 Kasparov theory ($KK$-theory) [See also 58J22]
19K56 Index theory [See also 58J20, 58J22]
19K99 None of the above, but in this section

19Lxx Topological $K$-theory [See also 55N15, 55R50, 55S25]
19L10 Riemann-Roch theorems, Chern characters
19L20 $J$-homomorphism, Adams operations [See also 55Q50]
19L41 Connective $K$-theory, cobordism [See also 55N22]
19L47 Equivariant $K$-theory [See also 55N91, 55P91, 55Q91, 55R91, 55S91]
19L50 Twisted $K$-theory; differential $K$-theory
19L64 Geometric applications of topological $K$-theory
19L99 None of the above, but in this section

19Mxx Miscellaneous applications of $K$-theory
19M05 Miscellaneous applications of $K$-theory
19M99 None of the above, but in this section

20-XX Group theory and generalizations
20-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to group theory
20-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to group theory
20-02 Research exposition (monographs, survey articles) pertaining to group theory
20-03 History of group theory [Consider also classification numbers pertaining to Section 01]
20-04 Software, source code, etc. for problems pertaining to group theory
20-06 Proceedings, conferences, collections, etc. pertaining to group theory
20-08 Computational methods for problems pertaining to group theory
20-11 Research data for problems pertaining to group theory

20Axx Foundations
20A05 Axiomatics and elementary properties of groups
20A10 Metamathematical considerations in group theory {For word problems, see 20F10}
20A15 Applications of logic to group theory
20A99 None of the above, but in this section
20Bxx Permutation groups
20B05 General theory for finite permutation groups
20B07 General theory for infinite permutation groups
20B10 Characterization theorems for permutation groups
20B15 Primitive groups
20B20 Multiply transitive finite groups
20B22 Multiply transitive infinite groups
20B25 Finite automorphism groups of algebraic, geometric, or combinatorial structures [See also 05Bxx, 12F10, 20G40, 20H30, 51-XX]
20B27 Infinite automorphism groups [See also 12F10]
20B30 Symmetric groups
20B35 Subgroups of symmetric groups
20B99 None of the above, but in this section

20Cxx Representation theory of groups {For representation rings and Burnside rings, see also 19A22}
20C05 Group rings of finite groups and their modules (group-theoretic aspects) [See also 16S34]
20C07 Group rings of infinite groups and their modules (group-theoretic aspects) [See also 16S34]
20C08 Hecke algebras and their representations
20C10 Integral representations of finite groups
20C11 p-adic representations of finite groups
20C12 Integral representations of infinite groups
20C15 Ordinary representations and characters
20C20 Modular representations and characters
20C25 Projective representations and multipliers
20C30 Representations of finite symmetric groups
20C32 Representations of infinite symmetric groups
20C33 Representations of finite groups of Lie type
20C34 Representations of sporadic groups
20C35 Applications of group representations to physics and other areas of science
20C99 None of the above, but in this section
20Dxx Abstract finite groups
20D05 Finite simple groups and their classification
20D06 Simple groups: alternating groups and groups of Lie type [See also 20Gxx]
20D08 Simple groups: sporadic groups
20D10 Finite solvable groups, theory of formations, Schunck classes, Fitting classes, \( \pi \)-length, ranks [See also 20F17]
20D15 Finite nilpotent groups, \( p \)-groups
20D20 Sylow subgroups, Sylow properties, \( \pi \)-groups, \( \pi \)-structure
20D25 Special subgroups (Frattini, Fitting, etc.)
20D30 Series and lattices of subgroups
20D35 Subnormal subgroups of abstract finite groups
20D40 Products of subgroups of abstract finite groups
20D45 Automorphisms of abstract finite groups
20D60 Arithmetic and combinatorial problems involving abstract finite groups
20D99 None of the above, but in this section

20Exx Structure and classification of infinite or finite groups
20E05 Free nonabelian groups
20E06 Free products of groups, free products with amalgamation, Higman-Neumann-Neumann extensions, and generalizations
20E07 Subgroup theorems; subgroup growth
20E08 Groups acting on trees [See also 20F65]
20E10 Quasivarieties and varieties of groups
20E15 Chains and lattices of subgroups, subnormal subgroups [See also 20F22]
20E18 Limits, profinite groups
20E22 Extensions, wreath products, and other compositions of groups [See also 20J05]
20E25 Local properties of groups
20E26 Residual properties and generalizations; residually finite groups
20E28 Maximal subgroups
20E32 Simple groups [See also 20D05]
20E34 General structure theorems for groups
20E36 Automorphisms of infinite groups [For automorphisms of finite groups, see 20D45]
20E42 Groups with a \( BN \)-pair; buildings [See also 51E24]
20E45 Conjugacy classes for groups
20E99 None of the above, but in this section
20Fxx Special aspects of infinite or finite groups

20F05 Generators, relations, and presentations of groups

20F06 Cancellation theory of groups; application of van Kampen diagrams [See also 57M05]

20F10 Word problems, other decision problems, connections with logic and automata (group-theoretic aspects) [See also 03B25, 03D05, 03D40, 06B25, 08A50, 20M05, 68Q70]

20F11 Groups of finite Morley rank [See also 03C45, 03C60]

20F12 Commutator calculus

20F14 Derived series, central series, and generalizations for groups

20F16 Solvable groups, supersolvable groups [See also 20D10]

20F17 Formations of groups, Fitting classes [See also 20D10]

20F18 Nilpotent groups [See also 20D15]

20F19 Generalizations of solvable and nilpotent groups

20F22 Other classes of groups defined by subgroup chains

20F24 FC-groups and their generalizations

20F28 Automorphism groups of groups [See also 20E36]

20F29 Representations of groups as automorphism groups of algebraic systems

20F34 Fundamental groups and their automorphisms (group-theoretic aspects) [See also 57M05, 57Sxx]

20F36 Braid groups; Artin groups

20F38 Other groups related to topology or analysis

20F40 Associated Lie structures for groups

20F45 Engel conditions

20F50 Periodic groups; locally finite groups

20F55 Reflection and Coxeter groups (group-theoretic aspects) [See also 22E40, 51F15]

20F60 Ordered groups (group-theoretic aspects) [See mainly 06F15]

20F65 Geometric group theory [See also 05C25, 20E08, 57Mxx]

20F67 Hyperbolic groups and nonpositively curved groups

20F69 Asymptotic properties of groups

20F70 Algebraic geometry over groups; equations over groups

20F99 None of the above, but in this section
20Gxx Linear algebraic groups and related topics {For arithmetic theory, see 11E57, 11H56; for geometric theory, see 14Lxx, 22Exx; for other methods in representation theory, see 15A30, 22E45, 22E46, 22E47, 22E50, 22E55}

20G05 Representation theory for linear algebraic groups
20G07 Structure theory for linear algebraic groups
20G10 Cohomology theory for linear algebraic groups
20G15 Cohomology theory for linear algebraic groups over arbitrary fields
20G20 Linear algebraic groups over the reals, the complexes, the quaternions
20G25 Linear algebraic groups over local fields and their integers
20G30 Linear algebraic groups over global fields and their integers
20G35 Linear algebraic groups over ad` eles and other rings and schemes
20G40 Linear algebraic groups over finite fields
20G41 Exceptional groups
20G42 Quantum groups (quantized function algebras) and their representations [See also 16T20, 17B37, 81R50]
20G43 Schur and $q$-Schur algebras
20G44 Kac-Moody groups
20G45 Applications of linear algebraic groups to the sciences
20G99 None of the above, but in this section

20Hxx Other groups of matrices [See also 15A30]
20H05 Unimodular groups, congruence subgroups (group-theoretic aspects) [See also 11F06, 19B37, 22E40, 51F20]
20H10 Fuchsian groups and their generalizations (group-theoretic aspects) [See also 11F06, 22E40, 30F35, 32Nxx]
20H15 Other geometric groups, including crystallographic groups [See also 51-XX, especially 51F15, and 82D25]
20H20 Other matrix groups over fields
20H25 Other matrix groups over rings
20H30 Other matrix groups over finite fields
20H99 None of the above, but in this section

20Jxx Connections of group theory with homological algebra and category theory
20J05 Homological methods in group theory
20J06 Cohomology of groups
20J15 Category of groups
20J99 None of the above, but in this section
20Kxx Abelian groups

20K01 Finite abelian groups {For sumsets, see 11B13, 11P70}

20K10 Torsion groups, primary groups and generalized primary groups

20K15 Torsion-free groups, finite rank

20K20 Torsion-free groups, infinite rank

20K21 Mixed groups

20K25 Direct sums, direct products, etc. for abelian groups

20K27 Subgroups of abelian groups

20K30 Automorphisms, homomorphisms, endomorphisms, etc. for abelian groups

20K35 Extensions of abelian groups

20K40 Homological and categorical methods for abelian groups

20K45 Topological methods for abelian groups [See also 22A05, 22B05]

20K99 None of the above, but in this section

20Lxx Groupoids (i.e. small categories in which all morphisms are isomorphisms) {For sets with a single binary operation, see 20N02; for topological groupoids, see 22A22, 58H05}

20L05 Groupoids (i.e. small categories in which all morphisms are isomorphisms) {For sets with a single binary operation, see 20N02; for topological groupoids, see 22A22, 58H05}

20L99 None of the above, but in this section

20Mxx Semigroups

20M05 Free semigroups, generators and relations, word problems [See also 03D40, 08A50, 20F10]

20M07 Varieties and pseudovarieties of semigroups

20M10 General structure theory for semigroups

20M11 Radical theory for semigroups

20M12 Ideal theory for semigroups

20M13 Arithmetic theory of semigroups

20M14 Commutative semigroups

20M15 Mappings of semigroups

20M17 Regular semigroups

20M18 Inverse semigroups

20M19 Orthodox semigroups

20M20 Semigroups of transformations, relations, partitions, etc. [See also 47D03, 47H20, 54H15]

20M25 Semigroup rings, multiplicative semigroups of rings [See also 16S36, 16Y60]
20M30 Representation of semigroups; actions of semigroups on sets
20M32 Algebraic monoids
20M35 Semigroups in automata theory, linguistics, etc. [See also 03D05, 68Q70, 68T50]
20M50 Connections of semigroups with homological algebra and category theory
20M75 Generalizations of semigroups
20M99 None of the above, but in this section

20Nxx Other generalizations of groups
20N02 Sets with a single binary operation (groupoids) {For groupoids in connection with category theory, see 20L05; for topological groupoids, see 22A22, 58H05}
20N05 Loops, quasigroups [See also 05Bxx]
20N10 Ternary systems (heaps, semiheaps, heapoids, etc.)
20N15 n-ary systems (n ≥ 3)
20N20 Hypergroups
20N25 Fuzzy groups [See also 03E72]
20N99 None of the above, but in this section

20Pxx Probabilistic methods in group theory [See also 60Bxx]
20P05 Probabilistic methods in group theory [See also 60Bxx]
20P99 None of the above, but in this section

22-XX Topological groups, Lie groups {For transformation groups, see 54H15, 57Sxx, 58-XX; for abstract harmonic analysis, see 43-XX}
22-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to topological groups
22-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to topological groups
22-02 Research exposition (monographs, survey articles) pertaining to topological groups
22-03 History of topological groups [Consider also classification numbers pertaining to Section 01]
22-04 Software, source code, etc. for problems pertaining to topological groups
22-06 Proceedings, conferences, collections, etc. pertaining to topological groups
22-08 Computational methods for problems pertaining to topological groups
22-11 Research data for problems pertaining to topological groups
22Axx Topological and differentiable algebraic systems {For topological rings and fields, see 12Jxx, 13Jxx, 16W80}

22A05 Structure of general topological groups
22A10 Analysis on general topological groups
22A15 Structure of topological semigroups
22A20 Analysis on topological semigroups
22A22 Topological groupoids (including differentiable and Lie groupoids) [See also 58H05]
22A25 Representations of general topological groups and semigroups
22A26 Topological semilattices, lattices and applications [See also 06B30, 06B35, 06F30]
22A30 Other topological algebraic systems and their representations
22A99 None of the above, but in this section

22Bxx Locally compact abelian groups (LCA groups)
22B05 General properties and structure of LCA groups
22B10 Structure of group algebras of LCA groups
22B99 None of the above, but in this section

22Cxx Compact groups
22C05 Compact groups
22C99 None of the above, but in this section

22Dxx Locally compact groups and their algebras
22D05 General properties and structure of locally compact groups
22D10 Unitary representations of locally compact groups
22D12 Other representations of locally compact groups
22D15 Group algebras of locally compact groups
22D20 Representations of group algebras
22D25 $C^*$-algebras and $W^*$-algebras in relation to group representations [See also 46Lxx]
22D30 Induced representations for locally compact groups
22D35 Duality theorems for locally compact groups
22D40 Ergodic theory on groups [See also 28Dxx]
22D45 Automorphism groups of locally compact groups
22D50 Rigidity in locally compact groups
22D55 Kazhdan’s property (T), the Haagerup property, and generalizations
22D99 None of the above, but in this section
22Exx Lie groups {For the topology of Lie groups and homogeneous spaces, see 57Sxx, 57Txx; for analysis thereon, see 43A80, 43A85, 43A90}

22E05 Local Lie groups [See also 34-XX, 35-XX, 58H05]

22E10 General properties and structure of complex Lie groups [See also 32M05]

22E15 General properties and structure of real Lie groups

22E20 General properties and structure of other Lie groups

22E25 Nilpotent and solvable Lie groups

22E27 Representations of nilpotent and solvable Lie groups (special orbital integrals, non-type I representations, etc.)

22E30 Analysis on real and complex Lie groups [See also 33C80, 43-XX]

22E35 Analysis on p-adic Lie groups

22E40 Discrete subgroups of Lie groups [See also 20Hxx, 32Nxx]

22E41 Continuous cohomology of Lie groups [See also 57R32, 57Txx, 58H10]

22E43 Structure and representation of the Lorentz group

22E45 Representations of Lie and linear algebraic groups over real fields: analytic methods {For the purely algebraic theory, see 20G05}

22E46 Semisimple Lie groups and their representations

22E47 Representations of Lie and real algebraic groups: algebraic methods (Verma modules, etc.) [See also 17B10]

22E50 Representations of Lie and linear algebraic groups over local fields [See also 20G05]

22E55 Representations of Lie and linear algebraic groups over global fields and adèle rings [See also 20G05]

22E57 Geometric Langlands program: representation-theoretic aspects [See also 14D24]

22E60 Lie algebras of Lie groups {For the algebraic theory of Lie algebras, see 17Bxx}

22E65 Infinite-dimensional Lie groups and their Lie algebras: general properties [See also 17B65, 58B25, 58D05 58H05]

22E66 Analysis on and representations of infinite-dimensional Lie groups

22E67 Loop groups and related constructions, group-theoretic treatment [See also 58D05]

22E70 Applications of Lie groups to the sciences; explicit representations [See also 81R05, 81R10]

22E99 None of the above, but in this section

22Fxx Noncompact transformation groups

22F05 General theory of group and pseudogroup actions {For topological properties of spaces with an action, see 57S20}

22F10 Measurable group actions [See also 22D40, 28Dxx, 37Axx]

22F30 Homogeneous spaces {For general actions on manifolds or preserving geometrical structures, see 57M60, 57Sxx; for discrete subgroups of Lie groups, see especially 22E40}

22F50 Groups as automorphisms of other structures

22F99 None of the above, but in this section
26-XX Real functions [See also 54C30]

26-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to real functions
26-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to real functions
26-02 Research exposition (monographs, survey papers) pertaining to real functions
26-03 History of real functions [Consider also classification numbers pertaining to Section 01]
26-04 Software, source code, etc. for problems pertaining to real functions
26-06 Proceedings, conferences, collections, etc. pertaining to real functions
26-08 Computational methods for problems pertaining to real functions
26-11 Research data for problems pertaining to real functions

26Axx Functions of one variable

26A03 Foundations: limits and generalizations, elementary topology of the line
26A06 One-variable calculus
26A09 Elementary functions
26A12 Rate of growth of functions, orders of infinity, slowly varying functions [See also 26A48]
26A15 Continuity and related questions (modulus of continuity, semicontinuity, discontinuities, etc.) for real functions in one variable {For properties determined by Fourier coefficients, see 42A16; for those determined by approximation properties, see 41A25, 41A27}
26A16 Lipschitz (Hölder) classes
26A18 Iteration of real functions in one variable [See also 37Bxx, 37Cxx, 37Exx, 39B12, 47H10, 54H25]
26A21 Classification of real functions; Baire classification of sets and functions [See also 03E15, 28A05, 54C50, 54H05]
26A24 Differentiation (real functions of one variable): general theory, generalized derivatives, mean value theorems [See also 28A15]
26A27 Nondifferentiability (nondifferentiable functions, points of nondifferentiability), discontinuous derivatives
26A30 Singular functions, Cantor functions, functions with other special properties
26A33 Fractional derivatives and integrals
26A36 Antidifferentiation
26A39 Denjoy and Perron integrals, other special integrals
26A42 Integrals of Riemann, Stieltjes and Lebesgue type [See also 28-XX]
26A45 Functions of bounded variation, generalizations
26A46 Absolutely continuous real functions in one variable
26A48 Monotonic functions, generalizations
26A51 Convexity of real functions in one variable, generalizations
26A99 None of the above, but in this section
26Bxx Functions of several variables
26B05 Continuity and differentiation questions
26B10 Implicit function theorems, Jacobians, transformations with several variables
26B12 Calculus of vector functions
26B15 Integration of real functions of several variables: length, area, volume [See also 28A75, 51M25]
26B20 Integral formulas of real functions of several variables (Stokes, Gauss, Green, etc.)
26B25 Convexity of real functions of several variables, generalizations
26B30 Absolutely continuous real functions of several variables, functions of bounded variation
26B35 Special properties of functions of several variables, Hölder conditions, etc.
26B40 Representation and superposition of functions
26B99 None of the above, but in this section

26Cxx Polynomials, rational functions in real analysis
26C05 Real polynomials: analytic properties, etc. [See also 12Dxx, 12Exx]
26C10 Real polynomials: location of zeros [See also 12D10, 30C15, 65H05]
26C15 Real rational functions [See also 14Pxx]
26C99 None of the above, but in this section

26Dxx Inequalities in real analysis {For maximal function inequalities, see 42B25; for functional inequalities, see 39B72; for probabilistic inequalities, see 60E15}
26D05 Inequalities for trigonometric functions and polynomials
26D07 Inequalities involving other types of functions
26D10 Inequalities involving derivatives and differential and integral operators
26D15 Inequalities for sums, series and integrals
26D20 Other analytical inequalities
26D99 None of the above, but in this section

26Exx Miscellaneous topics in real functions [See also 58Cxx]
26E05 Real-analytic functions [See also 32B05, 32C05]
26E10 $C^\infty$-functions, quasi-analytic functions [See also 58C25]
26E15 Calculus of functions on infinite-dimensional spaces [See also 46G05, 58Cxx]
26E20 Calculus of functions taking values in infinite-dimensional spaces [See also 46E40, 46G10, 58Cxx]
26E25 Set-valued functions [See also 28B20, 49J53, 54C60] {For nonsmooth analysis, see 49J52, 58Cxx, 90Cxx}
26E30 Non-Archimedean analysis [See also 12J25]
26E35 Nonstandard analysis [See also 03H05, 28E05, 54J05]
26E40 Constructive real analysis [See also 03F60]
26E50 Fuzzy real analysis [See also 03E72, 28E10]
26E60 Means [See also 47A64]
26E70 Real analysis on time scales or measure chains {For dynamic equations on time scales or measure chains, see 34N06}
26E99 None of the above, but in this section

28-XX Measure and integration {For analysis on manifolds, see 58-XX}
28-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to measure and integration
28-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to measure and integration
28-02 Research exposition (monographs, survey articles) pertaining to measure and integration
28-03 History of measure and integration [Consider also classification numbers pertaining to Section 01]
28-04 Software, source code, etc. for problems pertaining to measure and integration
28-06 Proceedings, conferences, collections, etc. pertaining to measure and integration
28-08 Computational methods for problems pertaining to measure and integration
28-11 Research data for problems pertaining to measure and integration

28Axx Classical measure theory
28A05 Classes of sets (Borel fields, σ-rings, etc.), measurable sets, Suslin sets, analytic sets [See also 03E15, 26A21, 54H05]
28A10 Real- or complex-valued set functions
28A12 Contents, measures, outer measures, capacities
28A15 Abstract differentiation theory, differentiation of set functions [See also 26A24]
28A20 Measurable and nonmeasurable functions, sequences of measurable functions, modes of convergence
28A25 Integration with respect to measures and other set functions
28A33 Spaces of measures, convergence of measures [See also 46E27, 60Bxx]
28A35 Measures and integrals in product spaces
28A50 Integration and disintegration of measures
28A51 Lifting theory [See also 46G15]
28A60 Measures on Boolean rings, measure algebras [See also 54H10]
28A75 Length, area, volume, other geometric measure theory [See also 26B15, 49Q15]
28A78 Hausdorff and packing measures
28A80 Fractals [See also 37Fxx]
28A99 None of the above, but in this section
<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28Bxx</td>
<td>Set functions, measures and integrals with values in abstract spaces</td>
</tr>
<tr>
<td>28B05</td>
<td>Vector-valued set functions, measures and integrals [See also 46G10]</td>
</tr>
<tr>
<td>28B10</td>
<td>Group- or semigroup-valued set functions, measures and integrals</td>
</tr>
<tr>
<td>28B15</td>
<td>Set functions, measures and integrals with values in ordered spaces</td>
</tr>
<tr>
<td>28B20</td>
<td>Set-valued set functions and measures; integration of set-valued functions; measurable selections [See also 26E25, 54C60, 54C65, 91B14]</td>
</tr>
<tr>
<td>28B99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>28Cxx</td>
<td>Set functions and measures on spaces with additional structure [See also 46G12, 58C35, 58D20]</td>
</tr>
<tr>
<td>28C05</td>
<td>Integration theory via linear functionals (Radon measures, Daniell integrals, etc.), representing set functions and measures</td>
</tr>
<tr>
<td>28C10</td>
<td>Set functions and measures on topological groups or semigroups, Haar measures, invariant measures [See also 22Axx, 43A05]</td>
</tr>
<tr>
<td>28C15</td>
<td>Set functions and measures on topological spaces (regularity of measures, etc.)</td>
</tr>
<tr>
<td>28C20</td>
<td>Set functions and measures and integrals in infinite-dimensional spaces (Wiener measure, Gaussian measure, etc.) [See also 46G12, 58C35, 58D20, 60B11]</td>
</tr>
<tr>
<td>28C99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>28Dxx</td>
<td>Measure-theoretic ergodic theory [See also 11K50, 11K55, 22D40, 37Axx, 47A35, 60Fxx, 60G10]</td>
</tr>
<tr>
<td>28D05</td>
<td>Measure-preserving transformations {For measure-preserving transformations and dynamical systems, see 37A05}</td>
</tr>
<tr>
<td>28D10</td>
<td>One-parameter continuous families of measure-preserving transformations {For dynamical systems aspect, see 37A10}</td>
</tr>
<tr>
<td>28D15</td>
<td>General groups of measure-preserving transformations {For dynamical systems aspects, see 37A15}</td>
</tr>
<tr>
<td>28D20</td>
<td>Entropy and other invariants</td>
</tr>
<tr>
<td>28D99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>28Exx</td>
<td>Miscellaneous topics in measure theory</td>
</tr>
<tr>
<td>28E05</td>
<td>Nonstandard measure theory [See also 03H05, 26E35]</td>
</tr>
<tr>
<td>28E10</td>
<td>Fuzzy measure theory [See also 03E72, 26E50, 94D05]</td>
</tr>
<tr>
<td>28E15</td>
<td>Other connections with logic and set theory</td>
</tr>
<tr>
<td>28E99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
30-XX Functions of a complex variable

30-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to functions of a complex variable

30-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to functions of a complex variable

30-02 Research exposition (monographs, survey articles) pertaining to functions of a complex variable

30-03 History of functions of a complex variable [Consider also classification numbers pertaining to Section 01]

30-04 Software, source code, etc. for problems pertaining to functions of a complex variable

30-06 Proceedings, conferences, collections, etc. pertaining to functions of a complex variable

30-08 Computational methods for problems pertaining to functions of a complex variable [See also 65Exx]

30-11 Research data for problems pertaining to functions of a complex variable

30Axx General properties of functions of one complex variable

30A05 Monogenic and polygenic functions of one complex variable

30A10 Inequalities in the complex plane

30A99 None of the above, but in this section

30Bxx Series expansions of functions of one complex variable

30B10 Power series (including lacunary series) in one complex variable

30B20 Random power series in one complex variable

30B30 Boundary behavior of power series in one complex variable; over-convergence

30B40 Analytic continuation of functions of one complex variable

30B50 Dirichlet series, exponential series and other series in one complex variable [See also 11M41, 42-XX]

30B60 Completeness problems, closure of a system of functions of one complex variable

30B70 Continued fractions; complex-analytic aspects [See also 11A55, 40A15]

30B99 None of the above, but in this section

30Cxx Geometric function theory

30C10 Polynomials and rational functions of one complex variable

30C15 Zeros of polynomials, rational functions, and other analytic functions of one complex variable (e.g., zeros of functions with bounded Dirichlet integral) {For algebraic theory, see 12D10; for real methods, see 26C10}

30C20 Conformal mappings of special domains

30C25 Covering theorems in conformal mapping theory

30C30 Schwarz-Christoffel-type mappings [See also 65E10]

30C35 General theory of conformal mappings

30C40 Kernel functions in one complex variable and applications
30C45 Special classes of univalent and multivalent functions of one complex variable (starlike, convex, bounded rotation, etc.)

30C50 Coefficient problems for univalent and multivalent functions of one complex variable

30C55 General theory of univalent and multivalent functions of one complex variable

30C62 Quasiconformal mappings in the complex plane

30C65 Quasiconformal mappings in $\mathbb{R}^n$, other generalizations

30C70 Extremal problems for conformal and quasiconformal mappings, variational methods

30C75 Extremal problems for conformal and quasiconformal mappings, other methods

30C80 Maximum principle, Schwarz’s lemma, Lindelöf principle, analogues and generalizations; subordination

30C85 Capacity and harmonic measure in the complex plane [See also 31A15]

30C99 None of the above, but in this section

30Dxx Entire and meromorphic functions of one complex variable, and related topics

30D05 Functional equations in the complex plane, iteration and composition of analytic functions of one complex variable [See also 34Mxx, 37Fxx, 39-XX]

30D10 Representations of entire functions of one complex variable by series and integrals

30D15 Special classes of entire functions of one complex variable and growth estimates

30D20 Entire functions of one complex variable, general theory

30D30 Meromorphic functions of one complex variable, general theory

30D35 Value distribution of meromorphic functions of one complex variable, Nevanlinna theory

30D40 Cluster sets, prime ends, boundary behavior

30D45 Normal functions of one complex variable, normal families

30D60 Quasi-analytic and other classes of functions of one complex variable

30D99 None of the above, but in this section

30Exx Miscellaneous topics of analysis in the complex plane

30E05 Moment problems and interpolation problems in the complex plane

30E10 Approximation in the complex plane

30E15 Asymptotic representations in the complex plane

30E20 Integration, integrals of Cauchy type, integral representations of analytic functions in the complex plane [See also 45Exx]

30E25 Boundary value problems in the complex plane [See also 45Exx]

30E99 None of the above, but in this section
### 30Fxx Riemann surfaces

- **30F10** Compact Riemann surfaces and uniformization [See also 14H15, 32G15]
- **30F15** Harmonic functions on Riemann surfaces
- **30F20** Classification theory of Riemann surfaces
- **30F25** Ideal boundary theory for Riemann surfaces
- **30F30** Differentials on Riemann surfaces
- **30F35** Fuchsian groups and automorphic functions (aspects of compact Riemann surfaces and uniformization) [See also 11Fxx, 20H10, 22E40, 32Gxx, 32Nxx]
- **30F40** Kleinian groups (aspects of compact Riemann surfaces and uniformization) [See also 20H10]
- **30F45** Conformal metrics (hyperbolic, Poincaré, distance functions)
- **30F50** Klein surfaces
- **30F60** Teichmüller theory [See also 32G15]
- **30F99** None of the above, but in this section

### 30Gxx Generalized function theory

- **30G06** Non-Archimedean function theory [See also 12J25]; nonstandard function theory [See also 03H05]
- **30G12** Finely holomorphic functions and topological function theory
- **30G20** Generalizations of Bers and Vekua type (pseudoanalytic, $p$-analytic, etc.)
- **30G25** Discrete analytic functions
- **30G30** Other generalizations of analytic functions (including abstract-valued functions)
- **30G35** Functions of hypercomplex variables and generalized variables
- **30G99** None of the above, but in this section

### 30Hxx Spaces and algebras of analytic functions of one complex variable

- **30H05** Spaces of bounded analytic functions of one complex variable
- **30H10** Hardy spaces [See also 42B30, 46E30]
- **30H15** Nevanlinna spaces and Smirnov spaces
- **30H20** Bergman spaces and Fock spaces [See also 46E30, 46E35]
- **30H25** Besov spaces and $Q_p$-spaces
- **30H30** Bloch spaces
- **30H35** BMO-spaces
- **30H40** Zygmund spaces
- **30H45** de Branges-Rovnyak spaces
- **30H50** Algebras of analytic functions of one complex variable
- **30H80** Corona theorems
- **30H99** None of the above, but in this section
30Jxx Function theory on the disc
30J05 Inner functions of one complex variable
30J10 Blaschke products
30J15 Singular inner functions of one complex variable
30J99 None of the above, but in this section

30Kxx Universal holomorphic functions of one complex variable
30K05 Universal Taylor series in one complex variable
30K10 Universal Dirichlet series in one complex variable
30K15 Universal functions of one complex variable
30K20 Compositional universality
30K99 None of the above, but in this section

30Lxx Analysis on metric spaces
30L05 Geometric embeddings of metric spaces
30L10 Quasiconformal mappings in metric spaces
30L15 Inequalities in metric spaces
30L99 None of the above, but in this section

31-XX Potential theory \{For probabilistic potential theory, see 60J45\}
31-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to potential theory
31-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to potential theory
31-02 Research exposition (monographs, survey articles) pertaining to potential theory
31-03 History of potential theory [Consider also classification numbers pertaining to Section 01]
31-04 Software, source code, etc. for problems pertaining to potential theory
31-06 Proceedings, conferences, collections, etc. pertaining to potential theory
31-08 Computational methods for problems pertaining to potential theory [See also 65Exx]
31-11 Research data for problems pertaining to potential theory

31Axx Two-dimensional potential theory
31A05 Harmonic, subharmonic, superharmonic functions in two dimensions
31A10 Integral representations, integral operators, integral equations methods in two dimensions
31A15 Potentials and capacity, harmonic measure, extremal length and related notions in two dimensions [See also 30C85]
31A20 Boundary behavior (theorems of Fatou type, etc.) of harmonic functions in two dimensions
31A25 Boundary value and inverse problems for harmonic functions in two dimensions
31A30 Biharmonic, polyharmonic functions and equations, Poisson’s equation in two dimensions
31A35 Connections of harmonic functions with differential equations in two dimensions
31A99 None of the above, but in this section

31Bxx Higher-dimensional potential theory
31B05 Harmonic, subharmonic, superharmonic functions in higher dimensions
31B10 Integral representations, integral operators, integral equations methods in higher dimensions
31B15 Potentials and capacities, extremal length and related notions in higher dimensions
31B20 Boundary value and inverse problems for harmonic functions in higher dimensions
31B25 Boundary behavior of harmonic functions in higher dimensions
31B30 Biharmonic and polyharmonic equations and functions in higher dimensions
31B35 Connections of harmonic functions with differential equations in higher dimensions
31B99 None of the above, but in this section

31Cxx Generalizations of potential theory
31C05 Harmonic, subharmonic, superharmonic functions on other spaces
31C10 Pluriharmonic and plurisubharmonic functions [See also 32U05]
31C12 Potential theory on Riemannian manifolds and other spaces [See also 53C20] {For Hodge theory, see 58A14}
31C15 Potentials and capacities on other spaces
31C20 Discrete potential theory
31C25 Dirichlet forms
31C35 Martin boundary theory [See also 60J50]
31C40 Fine potential theory; fine properties of sets and functions
31C45 Other generalizations (nonlinear potential theory, etc.)
31C99 None of the above, but in this section

31Dxx Axiomatic potential theory
31D05 Axiomatic potential theory
31D99 None of the above, but in this section

31Exx Potential theory on fractals and metric spaces
31E05 Potential theory on fractals and metric spaces
31E99 None of the above, but in this section
32-XX Several complex variables and analytic spaces \{For infinite-dimensional holomorphy, see also 46G20, 58B12\}

32-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to several complex variables and analytic spaces

32-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to several complex variables and analytic spaces

32-02 Research exposition (monographs, survey articles) pertaining to several complex variables and analytic spaces

32-03 History of several complex variables and analytic spaces [Consider also classification numbers pertaining to Section 01]

32-04 Software, source code, etc. for problems pertaining to several complex variables and analytic spaces

32-06 Proceedings, conferences, collections, etc. pertaining to several complex variables and analytic spaces

32-08 Computational methods for problems pertaining to several complex variables and analytic spaces [See also 65Exx]

32-11 Research data for problems pertaining to several complex variables and analytic spaces

32Axx Holomorphic functions of several complex variables

32A05 Power series, series of functions of several complex variables

32A08 Polynomials and rational functions of several complex variables

32A10 Holomorphic functions of several complex variables

32A12 Multifunctions of several complex variables

32A15 Entire functions of several complex variables

32A17 Special families of functions of several complex variables

32A18 Bloch functions, normal functions of several complex variables

32A19 Normal families of holomorphic functions, mappings of several complex variables, and related topics (taut manifolds etc.)

32A20 Meromorphic functions of several complex variables

32A22 Nevanlinna theory; growth estimates; other inequalities of several complex variables \{For geometric theory, see 32H25, 32H30\}

32A25 Integral representations; canonical kernels (Szegö, Bergman, etc.)

32A26 Integral representations, constructed kernels (e.g., Cauchy, Fantappiè-type kernels)

32A27 Residues for several complex variables [See also 32C30]

32A30 Other generalizations of function theory of one complex variable (should also be assigned at least one classification number from Section 30) \{For functions of several hypercomplex variables, see 30G35\}

32A35 $H^p$-spaces, Nevanlinna spaces of functions in several complex variables [See also 32M15, 42B30, 43A85, 46J15]

32A36 Bergman spaces of functions in several complex variables
| 32A37 | Other spaces of holomorphic functions of several complex variables (e.g., bounded mean oscillation (BMOA), vanishing mean oscillation (VMOA)) [See also 46Exx] |
| 32A38 | Algebras of holomorphic functions of several complex variables [See also 46J10, 46J15] |
| 32A40 | Boundary behavior of holomorphic functions of several complex variables |
| 32A45 | Hyperfunctions [See also 46F15] |
| 32A50 | Harmonic analysis of several complex variables [See mainly 43-XX] |
| 32A55 | Singular integrals of functions in several complex variables |
| 32A60 | Zero sets of holomorphic functions of several complex variables |
| 32A65 | Banach algebra techniques applied to functions of several complex variables [See also 46Jxx] |
| 32A70 | Functional analysis techniques applied to functions of several complex variables [See also 46Exx] |
| 32A99 | None of the above, but in this section |

| 32Bxx | Local analytic geometry [See also 13-XX, 14-XX] |
| 32B05 | Analytic algebras and generalizations, preparation theorems |
| 32B10 | Germs of analytic sets, local parametrization |
| 32B15 | Analytic subsets of affine space |
| 32B20 | Semi-analytic sets, subanalytic sets, and generalizations [See also 14P15] |
| 32B25 | Triangulation and topological properties of semi-analytic andsubanalytic sets, and related questions |
| 32B99 | None of the above, but in this section |

<p>| 32Cxx | Analytic spaces |
| 32C05 | Real-analytic manifolds, real-analytic spaces [See also 14Pxx, 58A07] |
| 32C07 | Real-analytic sets, complex Nash functions [See also 14P15, 14P20] |
| 32C09 | Embedding of real-analytic manifolds |
| 32C11 | Complex supergeometry [See also 14A22, 14M30, 58A50] |
| 32C15 | Complex spaces |
| 32C18 | Topology of analytic spaces |
| 32C20 | Normal analytic spaces |
| 32C22 | Embedding of analytic spaces |
| 32C25 | Analytic subsets and submanifolds |
| 32C30 | Integration on analytic sets and spaces, currents [See also 32A25, 32A27] |
| 32C35 | Analytic sheaves and cohomology groups [See also 14Fxx, 18F20, 55N30] |
| 32C36 | Local cohomology of analytic spaces |
| 32C37 | Duality theorems for analytic spaces |
| 32C38 | Sheaves of differential operators and their modules, D-modules [See also 14F10, 16S32, 35A27, 58J15] |</p>
<table>
<thead>
<tr>
<th>Codes</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>32C55</td>
<td>The Levi problem in complex spaces; generalizations</td>
</tr>
<tr>
<td>32C81</td>
<td>Applications of analytic spaces to physics and other areas of science</td>
</tr>
<tr>
<td>32C99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>32Dxx</td>
<td>Analytic continuation</td>
</tr>
<tr>
<td>32D05</td>
<td>Domains of holomorphy</td>
</tr>
<tr>
<td>32D10</td>
<td>Envelopes of holomorphy</td>
</tr>
<tr>
<td>32D15</td>
<td>Continuation of analytic objects in several complex variables</td>
</tr>
<tr>
<td>32D20</td>
<td>Removable singularities in several complex variables</td>
</tr>
<tr>
<td>32D26</td>
<td>Riemann domains</td>
</tr>
<tr>
<td>32D99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>32Exx</td>
<td>Holomorphic convexity</td>
</tr>
<tr>
<td>32E05</td>
<td>Holomorphically convex complex spaces, reduction theory</td>
</tr>
<tr>
<td>32E10</td>
<td>Stein spaces, Stein manifolds</td>
</tr>
<tr>
<td>32E20</td>
<td>Polynomial convexity, rational convexity, meromorphic convexity in several complex variables</td>
</tr>
<tr>
<td>32E30</td>
<td>Holomorphic, polynomial and rational approximation, and interpolation in several complex variables; Runge pairs</td>
</tr>
<tr>
<td>32E35</td>
<td>Global boundary behavior of holomorphic functions of several complex variables</td>
</tr>
<tr>
<td>32E40</td>
<td>The Levi problem</td>
</tr>
<tr>
<td>32E99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>32Fxx</td>
<td>Geometric convexity in several complex variables</td>
</tr>
<tr>
<td>32F10</td>
<td>$q$-convexity, $q$-concavity</td>
</tr>
<tr>
<td>32F17</td>
<td>Other notions of convexity in relation to several complex variables</td>
</tr>
<tr>
<td>32F18</td>
<td>Finite-type conditions for the boundary of a domain</td>
</tr>
<tr>
<td>32F27</td>
<td>Topological consequences of geometric convexity</td>
</tr>
<tr>
<td>32F32</td>
<td>Analytical consequences of geometric convexity (vanishing theorems, etc.)</td>
</tr>
<tr>
<td>32F45</td>
<td>Invariant metrics and pseudodistances in several complex variables</td>
</tr>
<tr>
<td>32F99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
32Gxx Deformations of analytic structures

32G05 Deformations of complex structures [See also 13D10, 16S80, 58H10, 58H15]
32G07 Deformations of special (e.g., CR) structures
32G08 Deformations of fiber bundles
32G10 Deformations of submanifolds and subspaces
32G13 Complex-analytic moduli problems {For algebraic moduli problems, see 14D20, 14D22, 14H10, 14J10} [See also 14H15, 14J15]
32G15 Moduli of Riemann surfaces, Teichmüller theory (complex-analytic aspects in several variables) [See also 14H15, 30Fxx]
32G20 Period matrices, variation of Hodge structure; degenerations [See also 14D05, 14D07, 14K30]
32G34 Moduli and deformations for ordinary differential equations (e.g., Knizhnik-Zamolodchikov equation) [See also 34Mxx]
32G81 Applications of deformations of analytic structures to the sciences
32G99 None of the above, but in this section

32Hxx Holomorphic mappings and correspondences

32H02 Holomorphic mappings, (holomorphic) embeddings and related questions in several complex variables
32H04 Meromorphic mappings in several complex variables
32H12 Boundary uniqueness of mappings in several complex variables
32H25 Picard-type theorems and generalizations for several complex variables {For function-theoretic properties, see 32A22}
32H30 Value distribution theory in higher dimensions {For function-theoretic properties, see 32A22}
32H35 Proper holomorphic mappings, finiteness theorems
32H40 Boundary regularity of mappings in several complex variables
32H50 Iteration of holomorphic maps, fixed points of holomorphic maps and related problems for several complex variables
32H99 None of the above, but in this section

32Jxx Compact analytic spaces {For Riemann surfaces, see 14Hxx, 30Fxx; for algebraic theory, see 14Jxx}

32J05 Compactification of analytic spaces
32J10 Algebraic dependence theorems
32J15 Compact complex surfaces
32J17 Compact complex 3-folds
32J18 Compact complex n-folds
32J25 Transcendental methods of algebraic geometry (complex-analytic aspects) [See also 14C30]
32J27 Compact Kähler manifolds: generalizations, classification
32J81 Applications of compact analytic spaces to the sciences
32J99 None of the above, but in this section
### 32Kxx Generalizations of analytic spaces

- **32K05** Banach analytic manifolds and spaces [See also 46G20, 58Bxx]
- **32K07** Formal and graded complex spaces [See also 58C50]
- **32K12** Holomorphic maps with infinite-dimensional arguments or values [See also 46G20]
- **32K15** Differentiable functions on analytic spaces, differentiable spaces [See also 58C25]
- **32K99** None of the above, but in this section

### 32Lxx Holomorphic fiber spaces [See also 55Rxx]

- **32L05** Holomorphic bundles and generalizations
- **32L10** Sheaves and cohomology of sections of holomorphic vector bundles, general results [See also 14F06, 14H60, 14J60, 18F20, 55N30]
- **32L15** Bundle convexity [See also 32F10]
- **32L20** Vanishing theorems
- **32L25** Twistor theory, double fibrations (complex-analytic aspects) [See also 53C28]
- **32L81** Applications of holomorphic fiber spaces to the sciences
- **32L99** None of the above, but in this section

### 32Mxx Complex spaces with a group of automorphisms

- **32M05** Complex Lie groups, group actions on complex spaces [See also 22E10]
- **32M10** Homogeneous complex manifolds [See also 14M17, 57T15]
- **32M12** Almost homogeneous manifolds and spaces [See also 14M17]
- **32M15** Hermitian symmetric spaces, bounded symmetric domains, Jordan algebras (complex-analytic aspects) [See also 22E10, 22E40, 53C35, 57T15]
- **32M17** Automorphism groups of $\mathbb{C}^n$ and affine manifolds
- **32M18** Automorphism groups of other complex spaces
- **32M25** Complex vector fields, holomorphic foliations, $\mathbb{C}$-actions
- **32M99** None of the above, but in this section

### 32Nxx Automorphic functions [See also 11Fxx, 20H10, 22E40, 30F35]

- **32N05** General theory of automorphic functions of several complex variables
- **32N10** Automorphic forms in several complex variables
- **32N15** Automorphic functions in symmetric domains
- **32N99** None of the above, but in this section

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78
32Pxx Non-Archimedean analysis (should also be assigned at least one other classification number from Section 32 describing the type of problem)

32P05 Non-Archimedean analysis (should also be assigned at least one other classification number from Section 32 describing the type of problem)

32P99 None of the above, but in this section

32Qxx Complex manifolds

32Q02 Special domains (Reinhardt, Hartogs, circular, tube, etc.) in $\mathbb{C}^n$ and complex manifolds

32Q05 Negative curvature complex manifolds

32Q10 Positive curvature complex manifolds

32Q15 Kähler manifolds

32Q20 Kähler-Einstein manifolds [See also 53Cxx]

32Q25 Calabi-Yau theory (complex-analytic aspects) [See also 14J32]

32Q26 Notions of stability for complex manifolds

32Q28 Stein manifolds

32Q30 Uniformization of complex manifolds

32Q35 Complex manifolds as subdomains of Euclidean space

32Q40 Embedding theorems for complex manifolds

32Q45 Hyperbolic and Kobayashi hyperbolic manifolds

32Q55 Topological aspects of complex manifolds

32Q56 Oka principle and Oka manifolds

32Q57 Classification theorems for complex manifolds

32Q60 Almost complex manifolds

32Q65 Pseudoholomorphic curves

32Q99 None of the above, but in this section

32Sxx Complex singularities [See also 58Kxx]

32S05 Local complex singularities [See also 14J17]

32S10 Invariants of analytic local rings

32S15 Equisingularity (topological and analytic) [See also 14E15]

32S20 Global theory of complex singularities; cohomological properties [See also 14E15]

32S22 Relations with arrangements of hyperplanes [See also 52C35]

32S25 Complex surface and hypersurface singularities [See also 14J17]

32S30 Deformations of complex singularities; vanishing cycles [See also 14B07]

32S35 Mixed Hodge theory of singular varieties (complex-analytic aspects) [See also 14C30, 14D07]
<table>
<thead>
<tr>
<th>32S40</th>
<th>Monodromy; relations with differential equations and $D$-modules (complex-analytic aspects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32S45</td>
<td>Modifications; resolution of singularities (complex-analytic aspects) [See also 14E15]</td>
</tr>
<tr>
<td>32S50</td>
<td>Topological aspects of complex singularities: Lefschetz theorems, topological classification, invariants</td>
</tr>
<tr>
<td>32S55</td>
<td>Milnor fibration; relations with knot theory [See also 57K10, 57K45]</td>
</tr>
<tr>
<td>32S60</td>
<td>Stratifications; constructible sheaves; intersection cohomology (complex-analytic aspects) [See also 58Kxx]</td>
</tr>
<tr>
<td>32S65</td>
<td>Singularities of holomorphic vector fields and foliations</td>
</tr>
<tr>
<td>32S70</td>
<td>Other operations on complex singularities</td>
</tr>
<tr>
<td>32S99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>32Txx</th>
<th>Pseudoconvex domains</th>
</tr>
</thead>
<tbody>
<tr>
<td>32T05</td>
<td>Domains of holomorphy</td>
</tr>
<tr>
<td>32T15</td>
<td>Strongly pseudoconvex domains</td>
</tr>
<tr>
<td>32T20</td>
<td>Worm domains</td>
</tr>
<tr>
<td>32T25</td>
<td>Finite-type domains</td>
</tr>
<tr>
<td>32T27</td>
<td>Geometric and analytic invariants on weakly pseudoconvex boundaries</td>
</tr>
<tr>
<td>32T35</td>
<td>Exhaustion functions</td>
</tr>
<tr>
<td>32T40</td>
<td>Peak functions</td>
</tr>
<tr>
<td>32T99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>32Uxx</th>
<th>Pluripotential theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>32U05</td>
<td>Plurisubharmonic functions and generalizations [See also 31C10]</td>
</tr>
<tr>
<td>32U10</td>
<td>Plurisubharmonic exhaustion functions</td>
</tr>
<tr>
<td>32U15</td>
<td>General pluripotential theory</td>
</tr>
<tr>
<td>32U20</td>
<td>Capacity theory and generalizations</td>
</tr>
<tr>
<td>32U25</td>
<td>Lelong numbers</td>
</tr>
<tr>
<td>32U30</td>
<td>Removable sets in pluripotential theory</td>
</tr>
<tr>
<td>32U35</td>
<td>Plurisubharmonic extremal functions, pluricomplex Green functions</td>
</tr>
<tr>
<td>32U40</td>
<td>Currents</td>
</tr>
<tr>
<td>32U99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
32Vxx CR manifolds
32V05 CR structures, CR operators, and generalizations
32V10 CR functions
32V15 CR manifolds as boundaries of domains
32V20 Analysis on CR manifolds
32V25 Extension of functions and other analytic objects from CR manifolds
32V30 Embeddings of CR manifolds
32V35 Finite-type conditions on CR manifolds
32V40 Real submanifolds in complex manifolds
32V99 None of the above, but in this section

32Wxx Differential operators in several variables
32W05 $\mathcal{J}$ and $\mathcal{J}$-Neumann operators
32W10 $\partial_b$ and $\partial_b$-Neumann operators
32W20 Complex Monge-Ampère operators
32W25 Pseudodifferential operators in several complex variables
32W30 Heat kernels in several complex variables
32W50 Other partial differential equations of complex analysis in several variables
32W99 None of the above, but in this section

33-XX Special functions (33-XX deals with the properties of functions as functions) \{For orthogonal functions, see 42Cxx; for aspects of combinatorics, see 05Axx; for number-theoretic aspects, see 11-XX; for representation theory, see 22Exx\}

33-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to special functions
33-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to special functions
33-02 Research exposition (monographs, survey articles) pertaining to special functions
33-03 History of special functions [Consider also classification numbers pertaining to Section 01]
33-04 Software, source code, etc. for problems pertaining to special functions
33-06 Proceedings, conferences, collections, etc. pertaining to special functions
33-11 Research data for problems pertaining to special functions
33Bxx Elementary classical functions
33B10 Exponential and trigonometric functions
33B15 Gamma, beta and polygamma functions
33B20 Incomplete beta and gamma functions (error functions, probability integral, Fresnel integrals)
33B30 Higher logarithm functions
33B99 None of the above, but in this section

33Cxx Hypergeometric functions
33C05 Classical hypergeometric functions, \( _2F_1 \)
33C10 Bessel and Airy functions, cylinder functions, \( _0F_1 \)
33C15 Confluent hypergeometric functions, Whittaker functions, \( _1F_1 \)
33C20 Generalized hypergeometric series, \( _pF_q \)
33C45 Orthogonal polynomials and functions of hypergeometric type (Jacobi, Laguerre, Hermite, Askey scheme, etc.) {For general orthogonal polynomials and functions, see also 42C05}
33C47 Other special orthogonal polynomials and functions
33C50 Orthogonal polynomials and functions in several variables expressible in terms of special functions in one variable
33C52 Orthogonal polynomials and functions associated with root systems
33C55 Spherical harmonics
33C60 Hypergeometric integrals and functions defined by them (\( E, G, H \) and \( I \) functions)
33C65 Appell, Horn and Lauricella functions
33C67 Hypergeometric functions associated with root systems
33C70 Other hypergeometric functions and integrals in several variables
33C75 Elliptic integrals as hypergeometric functions
33C80 Connections of hypergeometric functions with groups and algebras, and related topics
33C90 Applications of hypergeometric functions
33C99 None of the above, but in this section

33Dxx Basic hypergeometric functions
33D05 \( q \)-gamma functions, \( q \)-beta functions and integrals
33D15 Basic hypergeometric functions in one variable, \( \phi _q s \)
33D45 Basic orthogonal polynomials and functions (Askey-Wilson polynomials, etc.)
33D50 Orthogonal polynomials and functions in several variables expressible in terms of basic hypergeometric functions in one variable
33D52 Basic orthogonal polynomials and functions associated with root systems (Macdonald polynomials, etc.)
33D60 Basic hypergeometric integrals and functions defined by them
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>33D65</td>
<td>Bibasic functions and multiple bases</td>
</tr>
<tr>
<td>33D67</td>
<td>Basic hypergeometric functions associated with root systems</td>
</tr>
<tr>
<td>33D70</td>
<td>Other basic hypergeometric functions and integrals in several variables</td>
</tr>
<tr>
<td>33D80</td>
<td>Connections of basic hypergeometric functions with quantum groups, Chevalley groups, $p$-adic groups, Hecke algebras, and related topics</td>
</tr>
<tr>
<td>33D90</td>
<td>Applications of basic hypergeometric functions</td>
</tr>
<tr>
<td>33D99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>33Exx</td>
<td>Other special functions</td>
</tr>
<tr>
<td>33E05</td>
<td>Elliptic functions and integrals</td>
</tr>
<tr>
<td>33E10</td>
<td>Lamé, Mathieu, and spheroidal wave functions</td>
</tr>
<tr>
<td>33E12</td>
<td>Mittag-Leffler functions and generalizations</td>
</tr>
<tr>
<td>33E15</td>
<td>Other wave functions</td>
</tr>
<tr>
<td>33E17</td>
<td>Painlevé-type functions</td>
</tr>
<tr>
<td>33E20</td>
<td>Other functions defined by series and integrals</td>
</tr>
<tr>
<td>33E30</td>
<td>Other functions coming from differential, difference and integral equations</td>
</tr>
<tr>
<td>33E50</td>
<td>Special functions in characteristic $p$ (gamma functions, etc.)</td>
</tr>
<tr>
<td>33E99</td>
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<tr>
<td>33Fxx</td>
<td>Computational aspects of special functions {For software etc., see 33-04}</td>
</tr>
<tr>
<td>33F05</td>
<td>Numerical approximation and evaluation of special functions [See also 65D20]</td>
</tr>
<tr>
<td>33F10</td>
<td>Symbolic computation of special functions (Gosper and Zeilberger algorithms, etc.) [See also 68W30]</td>
</tr>
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<td>33F99</td>
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</tbody>
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**34-XX Ordinary differential equations**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34-00</td>
<td>General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to ordinary differential equations</td>
</tr>
<tr>
<td>34-01</td>
<td>Introductory exposition (textbooks, tutorial papers, etc.) pertaining to ordinary differential equations</td>
</tr>
<tr>
<td>34-02</td>
<td>Research exposition (monographs, survey articles) pertaining to ordinary differential equations</td>
</tr>
<tr>
<td>34-03</td>
<td>History of ordinary differential equations [Consider also classification numbers pertaining to Section 01]</td>
</tr>
<tr>
<td>34-04</td>
<td>Software, source code, etc. for problems pertaining to ordinary differential equations</td>
</tr>
<tr>
<td>34-06</td>
<td>Proceedings, conferences, collections, etc. pertaining to ordinary differential equations</td>
</tr>
<tr>
<td>34-11</td>
<td>Research data for problems pertaining to ordinary differential equations</td>
</tr>
</tbody>
</table>
34Axx General theory for ordinary differential equations

34A05 Explicit solutions, first integrals of ordinary differential equations

34A06 Generalized ordinary differential equations (measure-differential equations, set-valued differential equations, etc.)

34A07 Fuzzy ordinary differential equations

34A08 Fractional ordinary differential equations and fractional differential inclusions

34A09 Implicit ordinary differential equations, differential-algebraic equations

34A12 Initial value problems, existence, uniqueness, continuous dependence and continuation of solutions to ordinary differential equations

34A25 Analytical theory of ordinary differential equations: series, transformations, transforms, operational calculus, etc. [See also 44-XX]

34A26 Geometric methods in ordinary differential equations

34A30 Linear ordinary differential equations and systems, general

34A33 Ordinary lattice differential equations

34A34 Nonlinear ordinary differential equations and systems, general theory

34A35 Ordinary differential equations of infinite order

34A36 Discontinuous ordinary differential equations

34A37 Ordinary differential equations with impulses

34A38 Hybrid systems of ordinary differential equations

34A40 Differential inequalities involving functions of a single real variable [See also 26D20]

34A45 Theoretical approximation of solutions to ordinary differential equations {For numerical analysis, see 65Lxx}

34A55 Inverse problems involving ordinary differential equations

34A60 Ordinary differential inclusions [See also 49J21, 49K21]

34A99 None of the above, but in this section

34Bxx Boundary value problems for ordinary differential equations {For ordinary differential operators, see 34Lxx}

34B05 Linear boundary value problems for ordinary differential equations

34B07 Linear boundary value problems for ordinary differential equations with nonlinear dependence on the spectral parameter

34B08 Parameter dependent boundary value problems for ordinary differential equations

34B09 Boundary eigenvalue problems for ordinary differential equations

34B10 Nonlocal and multipoint boundary value problems for ordinary differential equations

34B15 Nonlinear boundary value problems for ordinary differential equations

34B16 Singular nonlinear boundary value problems for ordinary differential equations

34B18 Positive solutions to nonlinear boundary value problems for ordinary differential equations
### 34Bxx Ordinary differential equations

- **34B20** Weyl theory and its generalizations for ordinary differential equations
- **34B24** Sturm-Liouville theory [See also 34Lxx]
- **34B27** Green’s functions for ordinary differential equations
- **34B30** Special ordinary differential equations (Mathieu, Hill, Bessel, etc.)
- **34B37** Boundary value problems with impulses for ordinary differential equations
- **34B40** Boundary value problems on infinite intervals for ordinary differential equations
- **34B45** Boundary value problems on graphs and networks for ordinary differential equations
- **34B60** Applications of boundary value problems involving ordinary differential equations
- **34B99** None of the above, but in this section

### 34Cxx Qualitative theory for ordinary differential equations [See also 37-XX]

- **34C05** Topological structure of integral curves, singular points, limit cycles of ordinary differential equations
- **34C07** Theory of limit cycles of polynomial and analytic vector fields (existence, uniqueness, bounds, Hilbert’s 16th problem and ramifications) for ordinary differential equations
- **34C08** Ordinary differential equations and connections with real algebraic geometry (fewnomials, desingularization, zeros of abelian integrals, etc.)
- **34C10** Oscillation theory, zeros, disconjugacy and comparison theory for ordinary differential equations
- **34C11** Growth and boundedness of solutions to ordinary differential equations
- **34C12** Monotone systems involving ordinary differential equations
- **34C14** Symmetries, invariants of ordinary differential equations
- **34C15** Nonlinear oscillations and coupled oscillators for ordinary differential equations
- **34C20** Transformation and reduction of ordinary differential equations and systems, normal forms
- **34C23** Bifurcation theory for ordinary differential equations [See also 37Gxx]
- **34C25** Periodic solutions to ordinary differential equations
- **34C26** Relaxation oscillations for ordinary differential equations
- **34C27** Almost and pseudo-almost periodic solutions to ordinary differential equations
- **34C28** Complex behavior and chaotic systems of ordinary differential equations [See also 37Dxx]
- **34C29** Averaging method for ordinary differential equations
- **34C37** Homoclinic and heteroclinic solutions to ordinary differential equations
- **34C40** Ordinary differential equations and systems on manifolds
- **34C41** Equivalence and asymptotic equivalence of ordinary differential equations
- **34C45** Invariant manifolds for ordinary differential equations
- **34C46** Multifrequency systems of ordinary differential equations
- **34C55** Hysteresis for ordinary differential equations
- **34C60** Qualitative investigation and simulation of ordinary differential equation models
- **34C99** None of the above, but in this section
34Dxx Stability theory for ordinary differential equations [See also 37C75, 93Dxx]

34D05 Asymptotic properties of solutions to ordinary differential equations
34D06 Synchronization of solutions to ordinary differential equations
34D08 Characteristic and Lyapunov exponents of ordinary differential equations
34D09 Dichotomy, trichotomy of solutions to ordinary differential equations
34D10 Perturbations of ordinary differential equations
34D15 Singular perturbations of ordinary differential equations
34D20 Stability of solutions to ordinary differential equations
34D23 Global stability of solutions to ordinary differential equations
34D30 Structural stability and analogous concepts of solutions to ordinary differential equations [See also 37C20]
34D35 Stability of manifolds of solutions to ordinary differential equations
34D45 Attractors of solutions to ordinary differential equations [See also 37C70, 37D45]
34D99 None of the above, but in this section

34Exx Asymptotic theory for ordinary differential equations

34E05 Asymptotic expansions of solutions to ordinary differential equations
34E10 Perturbations, asymptotics of solutions to ordinary differential equations
34E13 Multiple scale methods for ordinary differential equations
34E15 Singular perturbations, general theory for ordinary differential equations
34E17 Canard solutions to ordinary differential equations
34E18 Methods of nonstandard analysis for ordinary differential equations
34E20 Singular perturbations, turning point theory, WKB methods for ordinary differential equations
34E99 None of the above, but in this section

34Fxx Ordinary differential equations and systems with randomness [See also 34K50, 60H10, 93E03]

34F05 Ordinary differential equations and systems with randomness [See also 34K50, 60H10, 93E03]
34F10 Bifurcation of solutions to ordinary differential equations involving randomness
34F15 Resonance phenomena for ordinary differential equations involving randomness
34F99 None of the above, but in this section

34Gxx Differential equations in abstract spaces [See also 34Lxx, 37Kxx, 47Dxx, 47Hxx, 47Jxx, 58D25]

34G10 Linear differential equations in abstract spaces [See also 47D06, 47D09]
34G20 Nonlinear differential equations in abstract spaces [See also 47Hxx, 47Jxx]
34G25 Evolution inclusions
34G99 None of the above, but in this section
<table>
<thead>
<tr>
<th>34Hxx</th>
<th>Control problems including ordinary differential equations [See also 49J15, 49K15, 93C15]</th>
</tr>
</thead>
<tbody>
<tr>
<td>34H05</td>
<td>Control problems involving ordinary differential equations [See also 49J15, 49K15, 93C15]</td>
</tr>
<tr>
<td>34H10</td>
<td>Chaos control for problems involving ordinary differential equations</td>
</tr>
<tr>
<td>34H15</td>
<td>Stabilization of solutions to ordinary differential equations</td>
</tr>
<tr>
<td>34H20</td>
<td>Bifurcation control of ordinary differential equations</td>
</tr>
<tr>
<td>34H99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>34Kxx</th>
<th>Functional-differential equations (including equations with delayed, advanced or state-dependent argument)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34K04</td>
<td>Symmetries, invariants of functional-differential equations [See also 37C80]</td>
</tr>
<tr>
<td>34K05</td>
<td>General theory of functional-differential equations</td>
</tr>
<tr>
<td>34K06</td>
<td>Linear functional-differential equations</td>
</tr>
<tr>
<td>34K07</td>
<td>Theoretical approximation of solutions to functional-differential equations</td>
</tr>
<tr>
<td>34K08</td>
<td>Spectral theory of functional-differential operators</td>
</tr>
<tr>
<td>34K09</td>
<td>Functional-differential inclusions</td>
</tr>
<tr>
<td>34K10</td>
<td>Boundary value problems for functional-differential equations</td>
</tr>
<tr>
<td>34K11</td>
<td>Oscillation theory of functional-differential equations</td>
</tr>
<tr>
<td>34K12</td>
<td>Growth, boundedness, comparison of solutions to functional-differential equations [See also 37C35]</td>
</tr>
<tr>
<td>34K13</td>
<td>Periodic solutions to functional-differential equations [See also 37C27]</td>
</tr>
<tr>
<td>34K14</td>
<td>Almost and pseudo-almost periodic solutions to functional-differential equations</td>
</tr>
<tr>
<td>34K16</td>
<td>Heteroclinic and homoclinic orbits of functional-differential equations [See also 37C29]</td>
</tr>
<tr>
<td>34K17</td>
<td>Transformation and reduction of functional-differential equations and systems, normal forms</td>
</tr>
<tr>
<td>34K18</td>
<td>Bifurcation theory of functional-differential equations [See also 37Gxx]</td>
</tr>
<tr>
<td>34K19</td>
<td>Invariant manifolds of functional-differential equations</td>
</tr>
<tr>
<td>34K20</td>
<td>Stability theory of functional-differential equations [See also 37C75]</td>
</tr>
<tr>
<td>34K21</td>
<td>Stationary solutions of functional-differential equations</td>
</tr>
<tr>
<td>34K23</td>
<td>Complex (chaotic) behavior of solutions to functional-differential equations [See also 37D45]</td>
</tr>
<tr>
<td>34K24</td>
<td>Synchronization of functional-differential equations</td>
</tr>
<tr>
<td>34K25</td>
<td>Asymptotic theory of functional-differential equations</td>
</tr>
<tr>
<td>34K26</td>
<td>Singular perturbations of functional-differential equations</td>
</tr>
<tr>
<td>34K27</td>
<td>Perturbations of functional-differential equations</td>
</tr>
<tr>
<td>34K29</td>
<td>Inverse problems for functional-differential equations</td>
</tr>
<tr>
<td>34K30</td>
<td>Functional-differential equations in abstract spaces [See also 34Gxx, 35R09, 35R10, 47Jxx]</td>
</tr>
</tbody>
</table>
34K31 Lattice functional-differential equations
34K32 Implicit functional-differential equations
34K33 Averaging for functional-differential equations
34K34 Hybrid systems of functional-differential equations
34K35 Control problems for functional-differential equations [See also 49J21, 49K21, 93C23]
34K36 Fuzzy functional-differential equations
34K37 Functional-differential equations with fractional derivatives
34K38 Functional-differential inequalities
34K39 Discontinuous functional-differential equations
34K40 Neutral functional-differential equations
34K41 Functional-differential equations in the complex domain
34K42 Functional-differential equations on time scales or measure chains
34K43 Functional-differential equations with state-dependent arguments
34K45 Functional-differential equations with impulses
34K46 Stochastic functional-differential equations [See also 34Fxx, 60Hxx]
34K50 Qualitative investigation and simulation of models involving functional-differential equations
34K99 None of the above, but in this section

34Lxx Ordinary differential operators [See also 47E05]
34L05 General spectral theory of ordinary differential operators
34L10 Eigenfunctions, eigenfunction expansions, completeness of eigenfunctions of ordinary differential operators
34L15 Eigenvalues, estimation of eigenvalues, upper and lower bounds of ordinary differential operators
34L16 Numerical approximation of eigenvalues and of other parts of the spectrum of ordinary differential operators
34L20 Asymptotic distribution of eigenvalues, asymptotic theory of eigenfunctions for ordinary differential operators
34L25 Scattering theory, inverse scattering involving ordinary differential operators
34L30 Nonlinear ordinary differential operators
34L40 Particular ordinary differential operators (Dirac, one-dimensional Schrödinger, etc.)
34L99 None of the above, but in this section
34Mxx Ordinary differential equations in the complex domain [See also 30Dxx, 32G34]

34M03 Linear ordinary differential equations and systems in the complex domain

34M04 Nonlinear ordinary differential equations and systems in the complex domain

34M05 Entire and meromorphic solutions to ordinary differential equations in the complex domain

34M10 Oscillation, growth of solutions to ordinary differential equations in the complex domain

34M15 Algebraic aspects (differential-algebraic, hypertranscendence, group-theoretical) of ordinary differential equations in the complex domain

34M25 Formal solutions and transform techniques for ordinary differential equations in the complex domain

34M30 Asymptotics and summation methods for ordinary differential equations in the complex domain

34M35 Singularities, monodromy and local behavior of solutions to ordinary differential equations in the complex domain, normal forms

34M40 Stokes phenomena and connection problems (linear and nonlinear) for ordinary differential equations in the complex domain

34M45 Ordinary differential equations on complex manifolds

34M46 Spectral theory for ordinary differential operators in the complex domain

34M50 Inverse problems (Riemann-Hilbert, inverse differential Galois, etc.) for ordinary differential equations in the complex domain

34M55 Painlevé and other special ordinary differential equations in the complex domain; classification, hierarchies;

34M56 Isomonodromic deformations for ordinary differential equations in the complex domain

34M60 Singular perturbation problems for ordinary differential equations in the complex domain (complex WKB, turning points, steepest descent) [See also 34E20]

34M65 Topological structure of trajectories of ordinary differential equations in the complex domain

34M99 None of the above, but in this section

34Nxx Dynamic equations on time scales or measure chains {For real analysis on time scales, see 26E70}

34N05 Dynamic equations on time scales or measure chains {For real analysis on time scales or measure chains, see 26E70}

34N99 None of the above, but in this section

35-XX Partial differential equations

35-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to partial differential equations

35-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to partial differential equations

35-02 Research exposition (monographs, survey articles) pertaining to partial differential equations

35-03 History of partial differential equations [Consider also classification numbers pertaining to Section 01]

35-04 Software, source code, etc. for problems pertaining to partial differential equations

35-06 Proceedings, conferences, collections, etc. pertaining to partial differential equations

35-11 Research data for problems pertaining to partial differential equations
### 35Axx General topics in partial differential equations

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35A01</td>
<td>Existence problems for PDEs: global existence, local existence, non-existence</td>
</tr>
<tr>
<td>35A02</td>
<td>Uniqueness problems for PDEs: global uniqueness, local uniqueness, non-uniqueness</td>
</tr>
<tr>
<td>35A08</td>
<td>Fundamental solutions to PDEs</td>
</tr>
<tr>
<td>35A09</td>
<td>Classical solutions to PDEs</td>
</tr>
<tr>
<td>35A10</td>
<td>Cauchy-Kovalevskaya theorems</td>
</tr>
<tr>
<td>35A15</td>
<td>Variational methods applied to PDEs</td>
</tr>
<tr>
<td>35A16</td>
<td>Topological and monotonicity methods applied to PDEs</td>
</tr>
<tr>
<td>35A17</td>
<td>Parametrices in context of PDEs</td>
</tr>
<tr>
<td>35A18</td>
<td>Wave front sets in context of PDEs</td>
</tr>
<tr>
<td>35A20</td>
<td>Analyticity in context of PDEs</td>
</tr>
<tr>
<td>35A21</td>
<td>Singularity in context of PDEs</td>
</tr>
<tr>
<td>35A22</td>
<td>Transform methods (e.g., integral transforms) applied to PDEs</td>
</tr>
<tr>
<td>35A23</td>
<td>Inequalities applied to PDEs involving derivatives, differential and integral operators, or integrals</td>
</tr>
<tr>
<td>35A24</td>
<td>Methods of ordinary differential equations applied to PDEs</td>
</tr>
<tr>
<td>35A25</td>
<td>Other special methods applied to PDEs</td>
</tr>
<tr>
<td>35A27</td>
<td>Microlocal methods and methods of sheaf theory and homological algebra applied to PDEs [See also 32C38, 58J15]</td>
</tr>
<tr>
<td>35A30</td>
<td>Geometric theory, characteristics, transformations in context of PDEs [See also 58J70, 58J72]</td>
</tr>
<tr>
<td>35A35</td>
<td>Theoretical approximation in context of PDEs {For numerical analysis, see 65Mxx, 65Nxx}</td>
</tr>
<tr>
<td>35A99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

### 35Bxx Qualitative properties of solutions to partial differential equations

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35B05</td>
<td>Oscillation, zeros of solutions, mean value theorems, etc. in context of PDEs</td>
</tr>
<tr>
<td>35B06</td>
<td>Symmetries, invariants, etc. in context of PDEs</td>
</tr>
<tr>
<td>35B07</td>
<td>Axially symmetric solutions to PDEs</td>
</tr>
<tr>
<td>35B08</td>
<td>Entire solutions to PDEs</td>
</tr>
<tr>
<td>35B09</td>
<td>Positive solutions to PDEs</td>
</tr>
<tr>
<td>35B10</td>
<td>Periodic solutions to PDEs</td>
</tr>
<tr>
<td>35B15</td>
<td>Almost and pseudo-almost periodic solutions to PDEs</td>
</tr>
<tr>
<td>35B20</td>
<td>Perturbations in context of PDEs</td>
</tr>
<tr>
<td>35B25</td>
<td>Singular perturbations in context of PDEs</td>
</tr>
<tr>
<td>35B27</td>
<td>Homogenization in context of PDEs; PDEs in media with periodic structure [See also 74Q05, 74Q10, 76M50, 78M40, 80M40]</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>35B30</td>
<td>Dependence of solutions to PDEs on initial and/or boundary data and/or on parameters of PDEs [See also 37Cxx]</td>
</tr>
<tr>
<td>35B32</td>
<td>Bifurcations in context of PDEs [See also 34C23, 34F10, 34H20, 37F46, 37Gxx, 37H20, 35J20, 37L10, 37M20, 47J15, 58E05, 58E07, 58J55, 74G60, 74H60]</td>
</tr>
<tr>
<td>35B33</td>
<td>Critical exponents in context of PDEs</td>
</tr>
<tr>
<td>35B34</td>
<td>Resonance in context of PDEs [See also 34F15, 70J40, 70K28, 70K30, 81U24]</td>
</tr>
<tr>
<td>35B35</td>
<td>Stability in context of PDEs [See also 34Dxx, 37B25, 37C20, 37C75, 37F15, 37J25, 37K45, 37L15, 49K40, 58K25, 93Dxx]</td>
</tr>
<tr>
<td>35B36</td>
<td>Pattern formations in context of PDEs [See also 92C15]</td>
</tr>
<tr>
<td>35B38</td>
<td>Critical points of functionals in context of PDEs (e.g., energy functionals) [See also 57R70, 58K05, 58E05]</td>
</tr>
<tr>
<td>35B40</td>
<td>Asymptotic behavior of solutions to PDEs</td>
</tr>
<tr>
<td>35B41</td>
<td>Attractors [See also 34D45, 37B35, 37C70, 37D45, 37G35, 37L30, 37M22]</td>
</tr>
<tr>
<td>35B42</td>
<td>Inertial manifolds [See also 37L25]</td>
</tr>
<tr>
<td>35B44</td>
<td>Blow-up in context of PDEs</td>
</tr>
<tr>
<td>35B45</td>
<td>A priori estimates in context of PDEs</td>
</tr>
<tr>
<td>35B50</td>
<td>Maximum principles in context of PDEs</td>
</tr>
<tr>
<td>35B51</td>
<td>Comparison principles in context of PDEs</td>
</tr>
<tr>
<td>35B53</td>
<td>Liouville theorems and Phragmén-Lindelöf theorems in context of PDEs</td>
</tr>
<tr>
<td>35B60</td>
<td>Continuation and prolongation of solutions to PDEs [See also 58A15, 58A17, 58Hxx]</td>
</tr>
<tr>
<td>35B65</td>
<td>Smoothness and regularity of solutions to PDEs</td>
</tr>
<tr>
<td>35B99</td>
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</table>

**35Cxx Representations of solutions to partial differential equations**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35C05</td>
<td>Solutions to PDEs in closed form</td>
</tr>
<tr>
<td>35C06</td>
<td>Self-similar solutions to PDEs</td>
</tr>
<tr>
<td>35C07</td>
<td>Traveling wave solutions</td>
</tr>
<tr>
<td>35C08</td>
<td>Soliton solutions [See also 37K40]</td>
</tr>
<tr>
<td>35C09</td>
<td>Trigonometric solutions to PDEs</td>
</tr>
<tr>
<td>35C10</td>
<td>Series solutions to PDEs</td>
</tr>
<tr>
<td>35C11</td>
<td>Polynomial solutions to PDEs</td>
</tr>
<tr>
<td>35C15</td>
<td>Integral representations of solutions to PDEs</td>
</tr>
<tr>
<td>35C20</td>
<td>Asymptotic expansions of solutions to PDEs</td>
</tr>
<tr>
<td>35C99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
35Dxx Generalized solutions to partial differential equations
35D30 Weak solutions to PDEs
35D35 Strong solutions to PDEs
35D40 Viscosity solutions to PDEs
35D99 None of the above, but in this section

35Exx Partial differential equations and systems of partial differential equations with constant coefficients [See also 35N05]
35E05 Fundamental solutions to PDEs and systems of PDEs with constant coefficients
35E10 Convexity properties of solutions to PDEs and systems of PDEs with constant coefficients
35E15 Initial value problems for PDEs and systems of PDEs with constant coefficients
35E20 General theory of PDEs and systems of PDEs with constant coefficients
35E99 None of the above, but in this section

35Fxx General first-order partial differential equations and systems of first-order partial differential equations
35F05 Linear first-order PDEs
35F10 Initial value problems for linear first-order PDEs
35F15 Boundary value problems for linear first-order PDEs
35F16 Initial-boundary value problems for linear first-order PDEs
35F20 Nonlinear first-order PDEs
35F21 Hamilton-Jacobi equations {For calculus of variations and optimal control, see 49Lxx; for mechanics of particles and systems, see 70H20}
35F25 Initial value problems for nonlinear first-order PDEs
35F30 Boundary value problems for nonlinear first-order PDEs
35F31 Initial-boundary value problems for nonlinear first-order PDEs
35F35 Systems of linear first-order PDEs
35F40 Initial value problems for systems of linear first-order PDEs
35F45 Boundary value problems for systems of linear first-order PDEs
35F46 Initial-boundary value problems for systems of linear first-order PDEs
35F50 Systems of nonlinear first-order PDEs
35F55 Initial value problems for systems of nonlinear first-order PDEs
35F60 Boundary value problems for systems of nonlinear first-order PDEs
35F61 Initial-boundary value problems for systems of nonlinear first-order PDEs
35F99 None of the above, but in this section
35Gxx General higher-order partial differential equations and systems of higher-order partial differential equations

35G05 Linear higher-order PDEs
35G10 Initial value problems for linear higher-order PDEs
35G15 Boundary value problems for linear higher-order PDEs
35G16 Initial-boundary value problems for linear higher-order PDEs
35G20 Nonlinear higher-order PDEs
35G25 Initial value problems for nonlinear higher-order PDEs
35G30 Boundary value problems for nonlinear higher-order PDEs
35G31 Initial-boundary value problems for nonlinear higher-order PDEs
35G35 Systems of linear higher-order PDEs
35G40 Initial value problems for systems of linear higher-order PDEs
35G45 Boundary value problems for systems of linear higher-order PDEs
35G46 Initial-boundary value problems for systems of linear higher-order PDEs
35G50 Systems of nonlinear higher-order PDEs
35G55 Initial value problems for systems of nonlinear higher-order PDEs
35G60 Boundary value problems for systems of nonlinear higher-order PDEs
35G61 Initial-boundary value problems for systems of nonlinear higher-order PDEs
35G99 None of the above, but in this section

35Hxx Close-to-elliptic equations
35H10 Hypoelliptic equations
35H20 Subelliptic equations
35H30 Quasielliptic equations
35H99 None of the above, but in this section

35Jxx Elliptic equations and elliptic systems {For global analysis, analysis on manifolds, see 58J10, 58J20}
35J05 Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation [See also 31Axx, 31Bxx]
35J08 Green’s functions for elliptic equations
35J10 Schrödinger operator, Schrödinger equation {For ordinary differential equations, see 34L40; for operator theory, see 47D08; for quantum theory, see 81Q05; for statistical mechanics, see 82B44}
35J15 Second-order elliptic equations
35J20 Variational methods for second-order elliptic equations
35J25 Boundary value problems for second-order elliptic equations
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35J30</td>
<td>Higher-order elliptic equations [See also 31A30, 31B30]</td>
</tr>
<tr>
<td>35J35</td>
<td>Variational methods for higher-order elliptic equations</td>
</tr>
<tr>
<td>35J40</td>
<td>Boundary value problems for higher-order elliptic equations</td>
</tr>
<tr>
<td>35J46</td>
<td>First-order elliptic systems</td>
</tr>
<tr>
<td>35J47</td>
<td>Second-order elliptic systems</td>
</tr>
<tr>
<td>35J48</td>
<td>Higher-order elliptic systems</td>
</tr>
<tr>
<td>35J50</td>
<td>Variational methods for elliptic systems</td>
</tr>
<tr>
<td>35J56</td>
<td>Boundary value problems for first-order elliptic systems</td>
</tr>
<tr>
<td>35J57</td>
<td>Boundary value problems for second-order elliptic systems</td>
</tr>
<tr>
<td>35J58</td>
<td>Boundary value problems for higher-order elliptic systems</td>
</tr>
<tr>
<td>35J60</td>
<td>Nonlinear elliptic equations</td>
</tr>
<tr>
<td>35J61</td>
<td>Semilinear elliptic equations</td>
</tr>
<tr>
<td>35J62</td>
<td>Quasilinear elliptic equations</td>
</tr>
<tr>
<td>35J65</td>
<td>Nonlinear boundary value problems for linear elliptic equations</td>
</tr>
<tr>
<td>35J66</td>
<td>Nonlinear boundary value problems for nonlinear elliptic equations</td>
</tr>
<tr>
<td>35J67</td>
<td>Boundary values of solutions to elliptic equations and elliptic systems</td>
</tr>
<tr>
<td>35J70</td>
<td>Degenerate elliptic equations</td>
</tr>
<tr>
<td>35J75</td>
<td>Singular elliptic equations</td>
</tr>
<tr>
<td>35J86</td>
<td>Unilateral problems for linear elliptic equations and variational inequalities with linear elliptic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35J87</td>
<td>Unilateral problems for nonlinear elliptic equations and variational inequalities with nonlinear elliptic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35J88</td>
<td>Unilateral problems for elliptic systems and systems of variational inequalities with elliptic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35J91</td>
<td>Semilinear elliptic equations with Laplacian, bi-Laplacian or poly-Laplacian</td>
</tr>
<tr>
<td>35J92</td>
<td>Quasilinear elliptic equations with $p$-Laplacian</td>
</tr>
<tr>
<td>35J93</td>
<td>Quasilinear elliptic equations with mean curvature operator</td>
</tr>
<tr>
<td>35J94</td>
<td>Elliptic equations with infinity-Laplacian</td>
</tr>
<tr>
<td>35J96</td>
<td>Monge-Ampère equations {For complex Monge-Ampère operators, see 32W20; for parabolic Monge-Ampère equations, see 35K96}</td>
</tr>
<tr>
<td>35J99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
35Kxx Parabolic equations and parabolic systems \{For global analysis, analysis on manifolds, see 58J35\}

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35K05</td>
<td>Heat equation</td>
</tr>
<tr>
<td>35K08</td>
<td>Heat kernel</td>
</tr>
<tr>
<td>35K10</td>
<td>Second-order parabolic equations</td>
</tr>
<tr>
<td>35K15</td>
<td>Initial value problems for second-order parabolic equations</td>
</tr>
<tr>
<td>35K20</td>
<td>Initial-boundary value problems for second-order parabolic equations</td>
</tr>
<tr>
<td>35K25</td>
<td>Higher-order parabolic equations</td>
</tr>
<tr>
<td>35K30</td>
<td>Initial value problems for higher-order parabolic equations</td>
</tr>
<tr>
<td>35K35</td>
<td>Initial-boundary value problems for higher-order parabolic equations</td>
</tr>
<tr>
<td>35K40</td>
<td>Second-order parabolic systems</td>
</tr>
<tr>
<td>35K41</td>
<td>Higher-order parabolic systems</td>
</tr>
<tr>
<td>35K45</td>
<td>Initial value problems for second-order parabolic systems</td>
</tr>
<tr>
<td>35K46</td>
<td>Initial value problems for higher-order parabolic systems</td>
</tr>
<tr>
<td>35K51</td>
<td>Initial-boundary value problems for second-order parabolic systems</td>
</tr>
<tr>
<td>35K52</td>
<td>Initial-boundary value problems for higher-order parabolic systems</td>
</tr>
<tr>
<td>35K55</td>
<td>Nonlinear parabolic equations</td>
</tr>
<tr>
<td>35K57</td>
<td>Reaction-diffusion equations {For diffusion processes and reaction effects, see 47D07, 58J65, 60J60, 60J70, 74N25, 76R50, 76V05, 80A23, 82B24, 82C24, 92E20}</td>
</tr>
<tr>
<td>35K58</td>
<td>Semilinear parabolic equations</td>
</tr>
<tr>
<td>35K59</td>
<td>Quasilinear parabolic equations</td>
</tr>
<tr>
<td>35K60</td>
<td>Nonlinear initial, boundary and initial-boundary value problems for linear parabolic equations</td>
</tr>
<tr>
<td>35K61</td>
<td>Nonlinear initial, boundary and initial-boundary value problems for nonlinear parabolic equations</td>
</tr>
<tr>
<td>35K65</td>
<td>Degenerate parabolic equations</td>
</tr>
<tr>
<td>35K67</td>
<td>Singular parabolic equations</td>
</tr>
<tr>
<td>35K70</td>
<td>Ultraparabolic equations, pseudoparabolic equations, etc.</td>
</tr>
<tr>
<td>35K85</td>
<td>Unilateral problems for linear parabolic equations and variational inequalities with linear parabolic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35K86</td>
<td>Unilateral problems for nonlinear parabolic equations and variational inequalities with nonlinear parabolic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35K87</td>
<td>Unilateral problems for parabolic systems and systems of variational inequalities with parabolic operators [See also 35R35, 49J40]</td>
</tr>
<tr>
<td>35K90</td>
<td>Abstract parabolic equations</td>
</tr>
<tr>
<td>35K91</td>
<td>Semilinear parabolic equations with Laplacian, bi-Laplacian or poly-Laplacian</td>
</tr>
<tr>
<td>35K92</td>
<td>Quasilinear parabolic equations with $p$-Laplacian</td>
</tr>
<tr>
<td>35K93</td>
<td>Quasilinear parabolic equations with mean curvature operator</td>
</tr>
<tr>
<td>35K96</td>
<td>Parabolic Monge-Ampère equations</td>
</tr>
<tr>
<td>35K99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

95
35Lxx Hyperbolic equations and hyperbolic systems {For global analysis, see 58J45}

35L02 First-order hyperbolic equations
35L03 Initial value problems for first-order hyperbolic equations
35L04 Initial-boundary value problems for first-order hyperbolic equations
35L05 Wave equation
35L10 Second-order hyperbolic equations
35L15 Initial value problems for second-order hyperbolic equations
35L20 Initial-boundary value problems for second-order hyperbolic equations
35L25 Higher-order hyperbolic equations
35L30 Initial value problems for higher-order hyperbolic equations
35L35 Initial-boundary value problems for higher-order hyperbolic equations
35L40 First-order hyperbolic systems
35L45 Initial value problems for first-order hyperbolic systems
35L50 Initial-boundary value problems for first-order hyperbolic systems
35L51 Second-order hyperbolic systems
35L52 Initial value problems for second-order hyperbolic systems
35L53 Initial-boundary value problems for second-order hyperbolic systems
35L55 Higher-order hyperbolic systems
35L56 Initial value problems for higher-order hyperbolic systems
35L57 Initial-boundary value problems for higher-order hyperbolic systems
35L60 First-order nonlinear hyperbolic equations
35L65 Hyperbolic conservation laws
35L67 Shocks and singularities for hyperbolic equations [See also 58Kxx, 74J40, 76L05]
35L70 Second-order nonlinear hyperbolic equations
35L71 Second-order semilinear hyperbolic equations
35L72 Second-order quasilinear hyperbolic equations
35L75 Higher-order nonlinear hyperbolic equations
35L76 Higher-order semilinear hyperbolic equations
35L77 Higher-order quasilinear hyperbolic equations
35L80 Degenerate hyperbolic equations
35L81 Singular hyperbolic equations
35L82 Pseudohyperbolic equations
35L85 Unilateral problems for linear hyperbolic equations and variational inequalities with linear hyperbolic operators [See also 35R35, 49J40]
35L86 Unilateral problems for nonlinear hyperbolic equations and variational inequalities with nonlinear hyperbolic operators [See also 35R35, 49J40]

35L87 Unilateral problems for hyperbolic systems and systems of variational inequalities with hyperbolic operators [See also 35R35, 49J40]

35L90 Abstract hyperbolic equations

35L99 None of the above, but in this section

35Mxx Partial differential equations of mixed type and mixed-type systems of partial differential equations

35M10 PDEs of mixed type

35M11 Initial value problems for PDEs of mixed type

35M12 Boundary value problems for PDEs of mixed type

35M13 Initial-boundary value problems for PDEs of mixed type

35M30 Mixed-type systems of PDEs

35M31 Initial value problems for mixed-type systems of PDEs

35M32 Boundary value problems for mixed-type systems of PDEs

35M33 Initial-boundary value problems for mixed-type systems of PDEs

35M85 Unilateral problems for linear PDEs of mixed type and variational inequalities with partial differential operators of mixed type [See also 35R35, 49J40]

35M86 Unilateral problems for nonlinear PDEs of mixed type and variational inequalities with nonlinear partial differential operators of mixed type [See also 35R35, 49J40]

35M87 Unilateral problems for mixed-type systems of PDEs and systems of variational inequalities with partial differential operators of mixed type [See also 35R35, 49J40]

35M99 None of the above, but in this section

35Nxx Overdetermined problems for partial differential equations and systems of partial differential equations {For global analysis, see 58Hxx, 58J10, 58J15}

35N05 Overdetermined systems of PDEs with constant coefficients

35N10 Overdetermined systems of PDEs with variable coefficients

35N15 \bar{\partial}-Neumann problems and formal complexes in context of PDEs [See also 32W05, 32W10, 58J10]

35N20 Overdetermined initial value problems for PDEs and systems of PDEs

35N25 Overdetermined boundary value problems for PDEs and systems of PDEs

35N30 Overdetermined initial-boundary value problems for PDEs and systems of PDEs

35N99 None of the above, but in this section
35Pxx Spectral theory and eigenvalue problems for partial differential equations {For operator theory, see 47Axx, 47Bxx, 47F05}
35P05 General topics in linear spectral theory for PDEs
35P10 Completeness of eigenfunctions and eigenfunction expansions in context of PDEs
35P15 Estimates of eigenvalues in context of PDEs
35P20 Asymptotic distributions of eigenvalues in context of PDEs
35P25 Scattering theory for PDEs [See also 47A40]
35P30 Nonlinear eigenvalue problems and nonlinear spectral theory for PDEs
35P99 None of the above, but in this section

35Qxx Partial differential equations of mathematical physics and other areas of application [See also 35J05, 35J10, 35K05, 35L05]
35Q05 Euler-Poisson-Darboux equations
35Q07 Fuchsian PDEs
35Q15 Riemann-Hilbert problems in context of PDEs [See also 30E25, 31A25, 31B20]
35Q20 Boltzmann equations {For fluid mechanics, see 76P05; for statistical mechanics, see 82B40, 82C40, 82D05}
35Q30 Navier-Stokes equations {For fluid mechanics, see 76D05, 76D07, 76N10}
35Q31 Euler equations {For fluid mechanics, see 76D05, 76D07, 76N10}
35Q35 PDEs in connection with fluid mechanics
35Q40 PDEs in connection with quantum mechanics
35Q41 Time-dependent Schrödinger equations and Dirac equations {For quantum theory, see 81Q05; for relativity and gravitational theory, see 83A05, 83C10}
35Q51 Soliton equations {For dynamical systems and ergodic theory, see 37K40}
35Q53 KdV equations (Korteweg-de Vries equations) {For dynamical systems and ergodic theory, see 37K10}
35Q55 NLS equations (nonlinear Schrödinger equations) {For dynamical systems and ergodic theory, see 37K10}
35Q56 Ginzburg-Landau equations {For optics and electromagnetic theory, see 78A25}
35Q60 PDEs in connection with optics and electromagnetic theory
35Q61 Maxwell equations {For optics and electromagnetic theory, see 78A25; for relativity and gravitational theory, see 83C22}
35Q62 PDEs in connection with statistics
35Q68 PDEs in connection with computer science
35Q70 PDEs in connection with mechanics of particles and systems of particles
35Q74 PDEs in connection with mechanics of deformable solids
35Q75 PDEs in connection with relativity and gravitational theory
35Q76 Einstein equations {For several complex variables and analytic spaces, see 32Q40; for differential geometry, see 53C07; for relativity and gravitational theory, see 83C05, 83C25, 83D05}
35Q79 PDEs in connection with classical thermodynamics and heat transfer

35Q80 Transport equations {For calculus of variations and optimal control, see 49Q20; for fluid mechanics, see 76F25; for statistical mechanics, see 82C70, 82D75; for operations research, see 90B06; for mathematical programming, see 90C08}

35Q81 PDEs in connection with semiconductor devices {For statistical mechanics, see 82D37}

35Q82 PDEs in connection with statistical mechanics

35Q83 Vlasov equations {For statistical mechanics, see 82C70, 82D75}

35Q84 Fokker-Planck equations {For fluid mechanics, see 76X05, 76W05; for statistical mechanics, see 82C31}

35Q85 PDEs in connection with astronomy and astrophysics

35Q86 PDEs in connection with geophysics

35Q89 PDEs in connection with mean field game theory {For calculus of variations and optimal control, see 49N80; for game theory, see 91A16}

35Q90 PDEs in connection with mathematical programming

35Q91 PDEs in connection with game theory, economics, social and behavioral sciences

35Q92 PDEs in connection with biology, chemistry and other natural sciences

35Q93 PDEs in connection with control and optimization

35Q94 PDEs in connection with information and communication

35Q99 None of the above, but in this section

35Rxx Miscellaneous topics in partial differential equations {For equations on manifolds, see 32Wxx, 58Jxx; for manifolds of solutions, see 58Bxx; for stochastic PDEs, see 60H15}

35R01 PDEs on manifolds [See also 32Wxx, 53Cxx, 58Jxx]

35R02 PDEs on graphs and networks (ramified or polygonal spaces)

35R03 PDEs on Heisenberg groups, Lie groups, Carnot groups, etc.

35R05 PDEs with low regular coefficients and/or low regular data

35R06 PDEs with measure

35R07 PDEs on time scales

35R09 Integral partial differential equations [See also 45Kxx]

35R10 Functional partial differential equations

35R11 Fractional partial differential equations

35R12 Impulsive partial differential equations

35R13 Fuzzy partial differential equations

35R15 PDEs on infinite-dimensional (e.g., function) spaces (= PDEs in infinitely many variables) [See also 46Gxx, 58D25]
35R20 Operator partial differential equations (= PDEs on finite-dimensional spaces for abstract space valued functions) [See also 34Gxx, 47A50, 47D03, 47D06, 47D09, 47H20, 47Jxx]

35R25 Ill-posed problems for PDEs

35R30 Inverse problems for PDEs

35R35 Free boundary problems for PDEs

35R37 Moving boundary problems for PDEs

35R45 Partial differential inequalities and systems of partial differential inequalities

35R50 PDEs of infinite order

35R60 PDEs with randomness, stochastic partial differential equations [See also 60H15]

35R70 PDEs with multivalued right-hand sides

35R99 None of the above, but in this section

35Sxx Pseudodifferential operators and other generalizations of partial differential operators {For operator theory, see 47G30, 58J40}

35S05 Pseudodifferential operators as generalizations of partial differential operators [See also 32W25, 47G30, 47L80, 58J40]

35S10 Initial value problems for PDEs with pseudodifferential operators

35S15 Boundary value problems for PDEs with pseudodifferential operators

35S16 Initial-boundary value problems for PDEs with pseudodifferential operators

35S30 Fourier integral operators applied to PDEs [See also 43A32, 58J40]

35S35 Topological aspects for pseudodifferential operators in context of PDEs: intersection cohomology, stratified sets, etc. [See also 32C38, 32S40, 32S60, 58J15]

35S50 Paradifferential operators as generalizations of partial differential operators in context of PDEs

35S99 None of the above, but in this section

37-XX Dynamical systems and ergodic theory [See also 26A18, 28Dxx, 34Cxx, 34Dxx, 35Bxx, 46Lxx, 58Jxx, 70-XX]

37-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to dynamical systems and ergodic theory

37-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to dynamical systems and ergodic theory

37-02 Research exposition (monographs, survey articles) pertaining to dynamical systems and ergodic theory

37-03 History of dynamical systems and ergodic theory [Consider also classification numbers pertaining to Section 01]

37-04 Software, source code, etc. for problems pertaining to dynamical systems and ergodic theory

37-06 Proceedings, conferences, collections, etc. pertaining to dynamical systems and ergodic theory

37-11 Research data for problems pertaining to dynamical systems and ergodic theory
37Axx Ergodic theory [See also 28Dxx]

37A05 Dynamical aspects of measure-preserving transformations

37A10 Dynamical systems involving one-parameter continuous families of measure-preserving transformations

37A15 General groups of measure-preserving transformations and dynamical systems [See mainly 22Fxx]

37A17 Homogeneous flows [See also 22Fxx]

37A20 Algebraic ergodic theory, cocycles, orbit equivalence, ergodic equivalence relations

37A25 Ergodicity, mixing, rates of mixing

37A30 Ergodic theorems, spectral theory, Markov operators {For operator ergodic theory, see mainly 47A35}

37A35 Entropy and other invariants, isomorphism, classification in ergodic theory

37A40 Nonsingular (and infinite-measure preserving) transformations

37A45 Relations between ergodic theory and number theory [See also 11Kxx]

37A46 Relations between ergodic theory and harmonic analysis

37A50 Dynamical systems and their relations with probability theory and stochastic processes [See also 60Fxx, 60G10]

37A55 Dynamical systems and the theory of C*-algebras [See mainly 46L55]

37A60 Dynamical systems of statistical mechanics [See also 82Cxx]

37A99 None of the above, but in this section

37Bxx Topological dynamics

37B02 Dynamics in general topological spaces

37B05 Dynamical systems involving transformations and group actions with special properties (minimality, distality, proximality, expansivity, etc.)

37B10 Symbolic dynamics

37B15 Dynamical aspects of cellular automata {For computational aspects, see 68Q80}

37B20 Notions of recurrence and recurrent behavior in dynamical systems

37B25 Stability of topological dynamical systems

37B30 Index theory for dynamical systems, Morse-Conley indices

37B35 Gradient-like and recurrent behavior; isolated (locally maximal) invariant sets; attractors, repellers for topological dynamical systems

37B40 Topological entropy

37B45 Continua theory in dynamics

37B50 Multidimensional shifts of finite type

37B52 Tiling dynamics

37B55 Topological dynamics of nonautonomous systems

37B65 Approximate trajectories, pseudotrajectories, shadowing and related notions for topological dynamical systems

37B99 None of the above, but in this section
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37Cxx</td>
<td>Smooth dynamical systems: general theory [See also 34Cxx, 34Dxx]</td>
</tr>
<tr>
<td>37C05</td>
<td>Dynamical systems involving smooth mappings and diffeomorphisms</td>
</tr>
<tr>
<td>37C10</td>
<td>Dynamics induced by flows and semiflows</td>
</tr>
<tr>
<td>37C15</td>
<td>Topological and differentiable equivalence, conjugacy, moduli, classification of dynamical systems</td>
</tr>
<tr>
<td>37C20</td>
<td>Generic properties, structural stability of dynamical systems</td>
</tr>
<tr>
<td>37C25</td>
<td>Fixed points and periodic points of dynamical systems; fixed-point index theory, local dynamics</td>
</tr>
<tr>
<td>37C27</td>
<td>Periodic orbits of vector fields and flows</td>
</tr>
<tr>
<td>37C29</td>
<td>Homoclinic and heteroclinic orbits for dynamical systems</td>
</tr>
<tr>
<td>37C30</td>
<td>Functional analytic techniques in dynamical systems; zeta functions, (Ruelle-Frobenius) transfer operators, etc.</td>
</tr>
<tr>
<td>37C35</td>
<td>Orbit growth in dynamical systems</td>
</tr>
<tr>
<td>37C40</td>
<td>Smooth ergodic theory, invariant measures for smooth dynamical systems [See also 37Dxx]</td>
</tr>
<tr>
<td>37C45</td>
<td>Dimension theory of smooth dynamical systems</td>
</tr>
<tr>
<td>37C50</td>
<td>Approximate trajectories (pseudotrajectories, shadowing, etc.) in smooth dynamics</td>
</tr>
<tr>
<td>37C55</td>
<td>Periodic and quasi-periodic flows and diffeomorphisms</td>
</tr>
<tr>
<td>37C60</td>
<td>Nonautonomous smooth dynamical systems [See also 37B55]</td>
</tr>
<tr>
<td>37C65</td>
<td>Monotone flows as dynamical systems</td>
</tr>
<tr>
<td>37C70</td>
<td>Attractors and repellers of smooth dynamical systems and their topological structure</td>
</tr>
<tr>
<td>37C75</td>
<td>Stability theory for smooth dynamical systems</td>
</tr>
<tr>
<td>37C80</td>
<td>Symmetries and invariants of dynamical systems</td>
</tr>
<tr>
<td>37C81</td>
<td>Equivariant dynamical systems</td>
</tr>
<tr>
<td>37C83</td>
<td>Dynamical systems with singularities (billiards, etc.)</td>
</tr>
<tr>
<td>37C85</td>
<td>Dynamics induced by group actions other than ( \mathbb{Z} ) and ( \mathbb{R} ), and ( \mathbb{C} ) [See mainly 22Fxx, and also 32M25, 57R30, 57Sxx]</td>
</tr>
<tr>
<td>37C86</td>
<td>Foliations generated by dynamical systems</td>
</tr>
<tr>
<td>37C99</td>
<td>None of the above, but in this section</td>
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</tbody>
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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>37Dxx</td>
<td>Dynamical systems with hyperbolic behavior</td>
</tr>
<tr>
<td>37D05</td>
<td>Dynamical systems with hyperbolic orbits and sets</td>
</tr>
<tr>
<td>37D10</td>
<td>Invariant manifold theory for dynamical systems</td>
</tr>
<tr>
<td>37D15</td>
<td>Morse-Smale systems</td>
</tr>
<tr>
<td>37D20</td>
<td>Uniformly hyperbolic systems (expanding, Anosov, Axiom A, etc.)</td>
</tr>
<tr>
<td>37D25</td>
<td>Nonuniformly hyperbolic systems (Lyapunov exponents, Pesin theory, etc.)</td>
</tr>
<tr>
<td>37D30</td>
<td>Partially hyperbolic systems and dominated splittings</td>
</tr>
<tr>
<td>37D35</td>
<td>Thermodynamic formalism, variational principles, equilibrium states for dynamical systems</td>
</tr>
</tbody>
</table>
### 37Dxx Dynamical systems of geometric origin and hyperbolicity (geodesic and horocycle flows, etc.)
- 37D40
- 37D45
- 37D99 None of the above, but in this section

### 37Exx Low-dimensional dynamical systems
- 37E05 Dynamical systems involving maps of the interval (piecewise continuous, continuous, smooth)
- 37E10 Dynamical systems involving maps of the circle
- 37E15 Combinatorial dynamics (types of periodic orbits)
- 37E20 Universality and renormalization of dynamical systems [See also 37F25]
- 37E25 Dynamical systems involving maps of trees and graphs
- 37E30 Dynamical systems involving homeomorphisms and diffeomorphisms of planes and surfaces
- 37E35 Flows on surfaces
- 37E40 Dynamical aspects of twist maps
- 37E45 Rotation numbers and vectors
- 37E99 None of the above, but in this section

### 37Fxx Dynamical systems over complex numbers [See also 30D05, 32H50]
- 37F05 Dynamical systems involving relations and correspondences in one complex variable
- 37F10 Dynamics of complex polynomials, rational maps, entire and meromorphic functions; Fatou and Julia sets [See also 32A10, 32A20, 32H02, 32H04]
- 37F12 Critical orbits for holomorphic dynamical systems
- 37F15 Expanding holomorphic maps; hyperbolicity; structural stability of holomorphic dynamical systems
- 37F20 Combinatorics and topology in relation with holomorphic dynamical systems
- 37F25 Renormalization of holomorphic dynamical systems
- 37F30 Quasiconformal methods in holomorphic dynamics; quasiconformal dynamics
- 37F32 Fuchsian and Kleinian groups as dynamical systems
- 37F34 Teichmüller theory; moduli spaces of holomorphic dynamical systems
- 37F35 Conformal densities and Hausdorff dimension for holomorphic dynamical systems
- 37F40 Geometric limits in holomorphic dynamics
- 37F45 Holomorphic families of dynamical systems; holomorphic motions; semigroups of holomorphic maps
- 37F46 Bifurcations; parameter spaces in holomorphic dynamics; the Mandelbrot and Multibrot sets
- 37F50 Small divisors, rotation domains and linearization in holomorphic dynamics
- 37F75 Dynamical aspects of holomorphic foliations and vector fields [See also 32M25, 32S65, 34Mxx]
- 37F80 Higher-dimensional holomorphic and meromorphic dynamics
- 37F99 None of the above, but in this section
37Gxx Local and nonlocal bifurcation theory for dynamical systems [See also 34C23, 34K18]

37G05 Normal forms for dynamical systems
37G10 Bifurcations of singular points in dynamical systems
37G15 Bifurcations of limit cycles and periodic orbits in dynamical systems
37G20 Hyperbolic singular points with homoclinic trajectories in dynamical systems
37G25 Bifurcations connected with nontransversal intersection in dynamical systems
37G30 Infinite nonwandering sets arising in bifurcations of dynamical systems
37G35 Dynamical aspects of attractors and their bifurcations
37G40 Dynamical aspects of symmetries, equivariant bifurcation theory
37G99 None of the above, but in this section

37Hxx Random dynamical systems [See also 15B52, 34D08, 34F05, 47B80, 70L05, 82C05, 93Exx]

37H05 General theory of random and stochastic dynamical systems
37H10 Generation, random and stochastic difference and differential equations [See also 34F05, 34K50, 60H10, 60H15]
37H12 Random iteration
37H15 Random dynamical systems aspects of multiplicative ergodic theory, Lyapunov exponents [See also 34D08, 37Axx, 37Cxx, 37Dxx]
37H20 Bifurcation theory for random and stochastic dynamical systems [See also 37Gxx]
37H30 Stability theory for random and stochastic dynamical systems
37H99 None of the above, but in this section

37Jxx Dynamical aspects of finite-dimensional Hamiltonian and Lagrangian systems [See also 53Dxx, 70Fxx, 70Hxx]

37J05 General theory of finite-dimensional Hamiltonian and Lagrangian systems, Hamiltonian and Lagrangian structures, symmetries, invariants
37J10 Symplectic and canonical mappings
37J12 Fixed points and periodic points of finite-dimensional Hamiltonian and Lagrangian systems
37J20 Bifurcation problems for finite-dimensional Hamiltonian and Lagrangian systems
37J25 Stability problems for finite-dimensional Hamiltonian and Lagrangian systems
37J30 Obstructions to integrability for finite-dimensional Hamiltonian and Lagrangian systems (nonintegrability criteria)
37J35 Completely integrable finite-dimensional Hamiltonian systems, integration methods, integrability tests
37J37 Relations of finite-dimensional Hamiltonian and Lagrangian systems with Lie algebras and other algebraic structures
37J38 Relations of finite-dimensional Hamiltonian and Lagrangian systems with algebraic geometry, complex analysis, special functions

37J39 Relations of finite-dimensional Hamiltonian and Lagrangian systems with topology, geometry and differential geometry (symplectic geometry, Poisson geometry, etc.) [See also 53D20]

37J40 Perturbations of finite-dimensional Hamiltonian systems, normal forms, small divisors, KAM theory, Arnol’d diffusion

37J45 Periodic, homoclinic and heteroclinic orbits of finite-dimensional Hamiltonian systems

37J50 Action-minimizing orbits and measures for finite-dimensional Hamiltonian and Lagrangian systems; variational principles; degree-theoretic methods

37J55 Contact systems [See also 53D10]

37J60 Nonholonomic dynamical systems [See also 70F25]

37J65 Nonautonomous Hamiltonian dynamical systems (Painlevé equations, etc.)

37J70 Completely integrable discrete dynamical systems

37J99 None of the above, but in this section

37Kxx Dynamical system aspects of infinite-dimensional Hamiltonian and Lagrangian systems [See also 35Axx, 35Qxx]

37K05 General theory of infinite-dimensional Hamiltonian and Lagrangian systems, Hamiltonian and Lagrangian structures, symmetries, conservation laws

37K10 Completely integrable infinite-dimensional Hamiltonian and Lagrangian systems, integration methods, integrability tests, integrable hierarchies (KdV, KP, Toda, etc.)

37K15 Inverse spectral and scattering methods for infinite-dimensional Hamiltonian and Lagrangian systems

37K20 Relations of infinite-dimensional Hamiltonian and Lagrangian dynamical systems with algebraic geometry, complex analysis, and special functions [See also 14H70]

37K25 Relations of infinite-dimensional Hamiltonian and Lagrangian dynamical systems with topology, geometry and differential geometry

37K30 Relations of infinite-dimensional Hamiltonian and Lagrangian dynamical systems with infinite-dimensional Lie algebras and other algebraic structures

37K35 Lie-Bäcklund and other transformations for infinite-dimensional Hamiltonian and Lagrangian systems

37K40 Soliton theory, asymptotic behavior of solutions of infinite-dimensional Hamiltonian systems

37K45 Stability problems for infinite-dimensional Hamiltonian and Lagrangian systems

37K50 Bifurcation problems for infinite-dimensional Hamiltonian and Lagrangian systems

37K55 Perturbations, KAM for infinite-dimensional Hamiltonian and Lagrangian systems

37K58 Variational principles and methods for infinite-dimensional Hamiltonian and Lagrangian systems

37K60 Lattice dynamics; integrable lattice equations [See also 37L60]

37K99 None of the above, but in this section
### 37Lxx Infinite-dimensional dissipative dynamical systems [See also 35Bxx, 35Qxx]

- **37L05** General theory of infinite-dimensional dissipative dynamical systems, nonlinear semigroups, evolution equations
- **37L10** Normal forms, center manifold theory, bifurcation theory for infinite-dimensional dissipative dynamical systems
- **37L15** Stability problems for infinite-dimensional dissipative dynamical systems
- **37L20** Symmetries of infinite-dimensional dissipative dynamical systems
- **37L25** Inertial manifolds and other invariant attracting sets of infinite-dimensional dissipative dynamical systems
- **37L30** Infinite-dimensional dissipative dynamical systems--attractors and their dimensions, Lyapunov exponents
- **37L40** Invariant measures for infinite-dimensional dissipative dynamical systems
- **37L45** Hyperbolicity; Lyapunov functions for infinite-dimensional dissipative dynamical systems
- **37L50** Noncompact semigroups; dispersive equations; perturbations of infinite-dimensional dissipative dynamical systems
- **37L55** Infinite-dimensional random dynamical systems; stochastic equations [See also 35R60, 60H10, 60H15]
- **37L60** Lattice dynamics and infinite-dimensional dissipative dynamical systems [See also 37K60]
- **37L65** Special approximation methods (nonlinear Galerkin, etc.) for infinite-dimensional dissipative dynamical systems
- **37L99** None of the above, but in this section

### 37Mxx Approximation methods and numerical treatment of dynamical systems {For numerical analysis, see also 65Pxx; for software etc., see 37-04}

- **37M05** Simulation of dynamical systems
- **37M10** Time series analysis of dynamical systems
- **37M15** Discretization methods and integrators (symplectic, variational, geometric, etc.) for dynamical systems
- **37M20** Computational methods for bifurcation problems in dynamical systems
- **37M21** Computational methods for invariant manifolds of dynamical systems
- **37M22** Computational methods for attractors of dynamical systems
- **37M25** Computational methods for ergodic theory (approximation of invariant measures, computation of Lyapunov exponents, entropy, etc.)
- **37M99** None of the above, but in this section

### 37Nxx Applications of dynamical systems

- **37N05** Dynamical systems in classical and celestial mechanics [See mainly 70Fxx, 70Hxx, 70Kxx]
- **37N10** Dynamical systems in fluid mechanics, oceanography and meteorology [See mainly 76-XX, especially 76D05, 76F20, 86A05, 86A10]
- **37N15** Dynamical systems in solid mechanics [See mainly 74Hxx]
- **37N20** Dynamical systems in other branches of physics (quantum mechanics, general relativity, laser physics)
37N25 Dynamical systems in biology [See also 92-XX]
37N30 Dynamical systems in numerical analysis [See also 65-XX]
37N35 Dynamical systems in control [See also 93-XX]
37N40 Dynamical systems in optimization and economics [See also 90-XX, 91-XX]
37N99 None of the above, but in this section

37Pxx Arithmetic and non-Archimedean dynamical systems [See also 11S82, 37A45]
37P05 Arithmetic and non-Archimedean dynamical systems involving polynomial and rational maps
37P10 Arithmetic and non-Archimedean dynamical systems involving analytic and meromorphic maps
37P15 Dynamical systems over global ground fields
37P20 Dynamical systems over non-Archimedean local ground fields
37P25 Dynamical systems over finite ground fields
37P30 Height functions; Green functions; invariant measures in arithmetic and non-Archimedean dynamical systems [See also 11G50, 14G40]
37P35 Arithmetic properties of periodic points
37P40 Non-Archimedean Fatou and Julia sets
37P45 Families and moduli spaces in arithmetic and non-Archimedean dynamical systems
37P50 Dynamical systems on Berkovich spaces
37P55 Arithmetic dynamics on general algebraic varieties
37P99 None of the above, but in this section

39-XX Difference and functional equations
39-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to difference and functional equations
39-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to difference and functional equations
39-02 Research exposition (monographs, survey articles) pertaining to difference and functional equations
39-03 History of difference and functional equations [Consider also classification numbers pertaining to Section 01]
39-04 Software, source code, etc. for problems pertaining to difference and functional equations
39-06 Proceedings, conferences, collections, etc. pertaining to difference and functional equations
39-08 Computational methods for problems pertaining to difference and functional equations
39-11 Research data for problems pertaining to difference and functional equations
39Axx Difference equations \{For dynamic equations on time scales, see 34N05; for dynamical systems, see 37-XX\}

39A05 General theory of difference equations
39A06 Linear difference equations
39A10 Additive difference equations
39A12 Discrete version of topics in analysis
39A13 Difference equations, scaling \((q\text{-differences})\) [See also 33Dxx]
39A14 Partial difference equations
39A20 Multiplicative and other generalized difference equations, e.g., of Lyness type
39A21 Oscillation theory for difference equations
39A22 Growth, boundedness, comparison of solutions to difference equations
39A23 Periodic solutions of difference equations
39A24 Almost periodic solutions of difference equations
39A26 Fuzzy difference equations
39A27 Boundary value problems for difference equations
39A28 Bifurcation theory for difference equations
39A30 Stability theory for difference equations
39A33 Chaotic behavior of solutions of difference equations
39A35 Integrable difference and lattice equations; integrability tests
39A45 Difference equations in the complex domain
39A50 Stochastic difference equations
39A60 Applications of difference equations
39A70 Difference operators [See also 47B39]
39A99 None of the above, but in this section

39Bxx Functional equations and inequalities \[See also 30D05\]

39B05 General theory of functional equations and inequalities
39B12 Iteration theory, iterative and composite equations [See also 26A18, 30D05, 37-XX]
39B22 Functional equations for real functions [See also 26A51, 26B25]
39B32 Functional equations for complex functions [See also 30D05]
39B42 Matrix and operator functional equations [See also 47Jxx]
39B52 Functional equations for functions with more general domains and/or ranges
39B55 Orthogonal additivity and other conditional functional equations
39B62 Functional inequalities, including subadditivity, convexity, etc. [See also 26A51, 26B25, 26Dxx]
39B72 Systems of functional equations and inequalities
39B82 Stability, separation, extension, and related topics for functional equations [See also 46A22]
39B99 None of the above, but in this section
40-XX Sequences, series, summability

40-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to sequences, series, summability

40-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to sequences, series, summability

40-02 Research exposition (monographs, survey articles) pertaining to sequences, series, summability

40-03 History of sequences, series, summability [Consider also classification numbers pertaining to Section 01]

40-04 Software, source code, etc. for problems pertaining to sequences, series, summability

40-06 Proceedings, conferences, collections, etc. pertaining to sequences, series, summability

40-08 Computational methods for problems pertaining to sequences, series, summability

40-11 Research data for problems pertaining to sequences, series, summability

40Axx Convergence and divergence of infinite limiting processes

40A05 Convergence and divergence of series and sequences

40A10 Convergence and divergence of integrals

40A15 Convergence and divergence of continued fractions [See also 30B70]

40A20 Convergence and divergence of infinite products

40A25 Approximation to limiting values (summation of series, etc.) {For the Euler-Maclaurin summation formula, see 65B15}

40A30 Convergence and divergence of series and sequences of functions

40A35 Ideal and statistical convergence [See also 40G15]

40A99 None of the above, but in this section

40Bxx Multiple sequences and series

40B05 Multiple sequences and series (should also be assigned at least one other classification number in this section)

40B99 None of the above, but in this section

40Cxx General summability methods

40C05 Matrix methods for summability

40C10 Integral methods for summability

40C15 Function-theoretic methods (including power series methods and semicontinuous methods) for summability

40C99 None of the above, but in this section
40Dxx Direct theorems on summability
40D05 General theorems on summability
40D09 Structure of summability fields
40D10 Tauberian constants and oscillation limits in summability theory
40D15 Convergence factors and summability factors
40D20 Summability and bounded fields of methods
40D25 Inclusion and equivalence theorems in summability theory
40D99 None of the above, but in this section

40Exx Inversion theorems
40E05 Tauberian theorems, general
40E10 Growth estimates
40E15 Lacunary inversion theorems
40E20 Tauberian constants
40E99 None of the above, but in this section

40Fxx Absolute and strong summability (should also be assigned at least one other classification number in Section 40)
40F05 Absolute and strong summability (should also be assigned at least one other classification number in Section 40)
40F99 None of the above, but in this section

40Gxx Special methods of summability
40G05 Cesàro, Euler, Nörlund and Hausdorff methods
40G10 Abel, Borel and power series methods
40G15 Summability methods using statistical convergence [See also 40A35]
40G99 None of the above, but in this section

40Hxx Functional analytic methods in summability
40H05 Functional analytic methods in summability
40H99 None of the above, but in this section

40Jxx Summability in abstract structures (should also be assigned at least one other classification number from Section 40) [See also 43A55, 46A35, 46B15]
40J05 Summability in abstract structures (should also be assigned at least one other classification number from Section 40) [See also 43A55, 46A35, 46B15]
40J99 None of the above, but in this section
### 41-XX Approximations and expansions

{For approximation theory in the complex domain, see 30E05, 30E10; for trigonometric approximation and interpolation, see 42A10, 42A15; for numerical approximation, see 65Dxx}

<table>
<thead>
<tr>
<th>41-00</th>
<th>General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to approximations and expansions</th>
</tr>
</thead>
<tbody>
<tr>
<td>41-01</td>
<td>Introductory exposition (textbooks, tutorial papers, etc.) pertaining to approximations and expansions</td>
</tr>
<tr>
<td>41-02</td>
<td>Research exposition (monographs, survey articles) pertaining to approximations and expansions</td>
</tr>
<tr>
<td>41-03</td>
<td>History of approximations and expansions [Consider also classification numbers pertaining to Section 01]</td>
</tr>
<tr>
<td>41-04</td>
<td>Software, source code, etc. for problems pertaining to approximations and expansions</td>
</tr>
<tr>
<td>41-06</td>
<td>Proceedings, conferences, collections, etc. pertaining to approximations and expansions</td>
</tr>
<tr>
<td>41-11</td>
<td>Research data for problems pertaining to approximations and expansions</td>
</tr>
</tbody>
</table>

**41Axx Approximations and expansions**

{For approximation theory in the complex domain, see 30E05, 30E10; for trigonometric approximation and interpolation, see 42A10, 42A15; for numerical approximation, see 65Dxx}

<table>
<thead>
<tr>
<th>41A05</th>
<th>Interpolation in approximation theory [See also 42A15, 65D05]</th>
</tr>
</thead>
<tbody>
<tr>
<td>41A10</td>
<td>Approximation by polynomials {For approximation by trigonometric polynomials, see 42A10}</td>
</tr>
<tr>
<td>41A15</td>
<td>Spline approximation</td>
</tr>
<tr>
<td>41A17</td>
<td>Inequalities in approximation (Bernstein, Jackson, Nikol’skii-type inequalities)</td>
</tr>
<tr>
<td>41A20</td>
<td>Approximation by rational functions</td>
</tr>
<tr>
<td>41A21</td>
<td>Padé approximation</td>
</tr>
<tr>
<td>41A25</td>
<td>Rate of convergence, degree of approximation</td>
</tr>
<tr>
<td>41A27</td>
<td>Inverse theorems in approximation theory</td>
</tr>
<tr>
<td>41A28</td>
<td>Simultaneous approximation</td>
</tr>
<tr>
<td>41A29</td>
<td>Approximation with constraints</td>
</tr>
<tr>
<td>41A30</td>
<td>Approximation by other special function classes</td>
</tr>
<tr>
<td>41A35</td>
<td>Approximation by operators (in particular, by integral operators)</td>
</tr>
<tr>
<td>41A36</td>
<td>Approximation by positive operators</td>
</tr>
<tr>
<td>41A40</td>
<td>Saturation in approximation theory</td>
</tr>
<tr>
<td>41A44</td>
<td>Best constants in approximation theory</td>
</tr>
<tr>
<td>41A45</td>
<td>Approximation by arbitrary linear expressions</td>
</tr>
<tr>
<td>41A46</td>
<td>Approximation by arbitrary nonlinear expressions; widths and entropy</td>
</tr>
<tr>
<td>41A50</td>
<td>Best approximation, Chebyshev systems</td>
</tr>
<tr>
<td>41A52</td>
<td>Uniqueness of best approximation</td>
</tr>
</tbody>
</table>
41A55 Approximate quadratures
41A58 Series expansions (e.g., Taylor, Lidstone series, but not Fourier series)
41A60 Asymptotic approximations, asymptotic expansions (steepest descent, etc.) [See also 30E15]
41A63 Multidimensional problems (should also be assigned at least one other classification number from Section 41)
41A65 Abstract approximation theory (approximation in normed linear spaces and other abstract spaces)
41A80 Remainders in approximation formulas
41A81 Weighted approximation
41A99 None of the above, but in this section

42-XX Harmonic analysis on Euclidean spaces
42-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to harmonic analysis on Euclidean spaces
42-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to harmonic analysis on Euclidean spaces
42-02 Research exposition (monographs, survey articles) pertaining to harmonic analysis on Euclidean spaces
42-03 History of harmonic analysis on Euclidean spaces [Consider also classification numbers pertaining to Section 01]
42-04 Software, source code, etc. for problems pertaining to harmonic analysis on Euclidean spaces
42-06 Proceedings, conferences, collections, etc. pertaining to harmonic analysis on Euclidean spaces
42-08 Computational methods for problems pertaining to harmonic analysis on Euclidean spaces
42-11 Research data for problems pertaining to harmonic analysis on Euclidean spaces

42Axx Harmonic analysis in one variable
42A05 Trigonometric polynomials, inequalities, extremal problems
42A10 Trigonometric approximation
42A15 Trigonometric interpolation
42A16 Fourier coefficients, Fourier series of functions with special properties, special Fourier series {For automorphic theory, see mainly 11F30}
42A20 Convergence and absolute convergence of Fourier and trigonometric series
42A24 Summability and absolute summability of Fourier and trigonometric series
42A32 Trigonometric series of special types (positive coefficients, monotonic coefficients, etc.)
42A38 Fourier and Fourier-Stieltjes transforms and other transforms of Fourier type
42A45 Multipliers in one variable harmonic analysis
42A50 Conjugate functions, conjugate series, singular integrals
42A55 Lacunary series of trigonometric and other functions; Riesz products
42A61 Probabilistic methods for one variable harmonic analysis
42A63 Uniqueness of trigonometric expansions, uniqueness of Fourier expansions, Riemann theory, localization
42A65 Completeness of sets of functions in one variable harmonic analysis
42A70 Trigonometric moment problems in one variable harmonic analysis
42A75 Classical almost periodic functions, mean periodic functions [See also 43A60]
42A82 Positive definite functions in one variable harmonic analysis
42A85 Convolution, factorization for one variable harmonic analysis
42A99 None of the above, but in this section

42Bxx Harmonic analysis in several variables {For automorphic theory, see mainly 11F30}
42B05 Fourier series and coefficients in several variables
42B08 Summability in several variables
42B10 Fourier and Fourier-Stieltjes transforms and other transforms of Fourier type
42B15 Multipliers for harmonic analysis in several variables
42B20 Singular and oscillatory integrals (Calderón-Zygmund, etc.)
42B25 Maximal functions, Littlewood-Paley theory
42B30 $H^p$-spaces
42B35 Function spaces arising in harmonic analysis
42B37 Harmonic analysis and PDEs [See also 35-XX]
42B99 None of the above, but in this section

42Cxx Nontrigonometric harmonic analysis
42C05 Orthogonal functions and polynomials, general theory of nontrigonometric harmonic analysis [See also 33C45, 33C50, 33D45]
42C10 Fourier series in special orthogonal functions (Legendre polynomials, Walsh functions, etc.)
42C15 General harmonic expansions, frames
42C20 Other transformations of harmonic type
42C25 Uniqueness and localization for orthogonal series
42C30 Completeness of sets of functions in nontrigonometric harmonic analysis
42C40 Nontrigonometric harmonic analysis involving wavelets and other special systems
42C99 None of the above, but in this section
### 43-XX Abstract harmonic analysis {For other analysis on topological and Lie groups, see 22Exx}

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>43-00</td>
<td>General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-01</td>
<td>Introductory exposition (textbooks, tutorial papers, etc.) pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-02</td>
<td>Research exposition (monographs, survey articles) pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-03</td>
<td>History of abstract harmonic analysis [Consider also classification numbers pertaining to Section 01]</td>
</tr>
<tr>
<td>43-04</td>
<td>Software, source code, etc. for problems pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-06</td>
<td>Proceedings, conferences, collections, etc. pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-08</td>
<td>Computational methods for problems pertaining to abstract harmonic analysis</td>
</tr>
<tr>
<td>43-11</td>
<td>Research data for problems pertaining to abstract harmonic analysis</td>
</tr>
</tbody>
</table>

### 43Axx Abstract harmonic analysis {For other analysis on topological and Lie groups, see 22Exx}

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>43A05</td>
<td>Measures on groups and semigroups, etc.</td>
</tr>
<tr>
<td>43A07</td>
<td>Means on groups, semigroups, etc.; amenable groups</td>
</tr>
<tr>
<td>43A10</td>
<td>Measure algebras on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A15</td>
<td>$L^p$-spaces and other function spaces on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A17</td>
<td>Analysis on ordered groups, $H^p$-theory</td>
</tr>
<tr>
<td>43A20</td>
<td>$L^1$-algebras on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A22</td>
<td>Homomorphisms and multipliers of function spaces on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A25</td>
<td>Fourier and Fourier-Stieltjes transforms on locally compact and other abelian groups</td>
</tr>
<tr>
<td>43A30</td>
<td>Fourier and Fourier-Stieltjes transforms on nonabelian groups and on semigroups, etc.</td>
</tr>
<tr>
<td>43A32</td>
<td>Other transforms and operators of Fourier type</td>
</tr>
<tr>
<td>43A35</td>
<td>Positive definite functions on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A40</td>
<td>Character groups and dual objects</td>
</tr>
<tr>
<td>43A45</td>
<td>Spectral synthesis on groups, semigroups, etc.</td>
</tr>
<tr>
<td>43A46</td>
<td>Special sets (thin sets, Kronecker sets, Helson sets, Ditkin sets, Sidon sets, etc.)</td>
</tr>
<tr>
<td>43A50</td>
<td>Convergence of Fourier series and of inverse transforms</td>
</tr>
<tr>
<td>43A55</td>
<td>Summability methods on groups, semigroups, etc. [See also 40J05]</td>
</tr>
<tr>
<td>43A60</td>
<td>Almost periodic functions on groups and semigroups and their generalizations (recurrent functions, distal functions, etc.); almost automorphic functions</td>
</tr>
<tr>
<td>43A62</td>
<td>Harmonic analysis on hypergroups</td>
</tr>
<tr>
<td>43A65</td>
<td>Representations of groups, semigroups, etc. (aspects of abstract harmonic analysis) [See also 22A10, 22A20, 22Dxx, 22E45]</td>
</tr>
</tbody>
</table>
43A70 Analysis on specific locally compact and other abelian groups [See also 11R56, 22B05]
43A75 Harmonic analysis on specific compact groups
43A77 Harmonic analysis on general compact groups
43A80 Analysis on other specific Lie groups [See also 22Exx]
43A85 Harmonic analysis on homogeneous spaces
43A90 Harmonic analysis and spherical functions [See also 22E45, 22E46, 33C55]
43A95 Categorical methods for abstract harmonic analysis [See also 46Mxx]
43A99 None of the above, but in this section

44-XX Integral transforms, operational calculus {For fractional derivatives and integrals, see 26A33; for Fourier transforms, see 42A38, 42B10; for integral transforms in distribution spaces, see 46F12; for numerical methods, see 65R10}

44-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to integral transforms
44-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to integral transforms
44-02 Research exposition (monographs, survey articles) pertaining to integral transforms
44-03 History of integral transforms [Consider also classification numbers pertaining to Section 01]
44-04 Software, source code, etc. for problems pertaining to integral transforms
44-06 Proceedings, conferences, collections, etc. pertaining to integral transforms
44-11 Research data for problems pertaining to integral transforms

44Axx Integral transforms, operational calculus {For fractional derivatives and integrals, see 26A33; for Fourier transforms, see 42A38, 42B10; for integral transforms in distribution spaces, see 46F12; for numerical methods, see 65R10}

44A05 General integral transforms [See also 42A38]
44A10 Laplace transform
44A12 Radon transform [See also 92C55]
44A15 Special integral transforms (Legendre, Hilbert, etc.)
44A20 Integral transforms of special functions
44A30 Multiple integral transforms
44A35 Convolution as an integral transform
44A40 Calculus of Mikusiński and other operational calculi
44A45 Classical operational calculus
44A55 Discrete operational calculus
44A60 Moment problems {For trigonometric moment problems, see 42A70}
44A99 None of the above, but in this section

115
45-XX Integral equations

45-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to integral equations
45-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to integral equations
45-02 Research exposition (monographs, survey articles) pertaining to integral equations
45-03 History of integral equations [Consider also classification numbers pertaining to Section 01]
45-04 Software, source code, etc. for problems pertaining to integral equations
45-06 Proceedings, conferences, collections, etc. pertaining to integral equations
45-11 Research data for problems pertaining to integral equations

45Axx Linear integral equations
45A05 Linear integral equations
45A99 None of the above, but in this section

45Bxx Fredholm integral equations
45B05 Fredholm integral equations
45B99 None of the above, but in this section

45Cxx Eigenvalue problems for integral equations [See also 34Lxx, 35Pxx, 45P05, 47A75]
45C05 Eigenvalue problems for integral equations [See also 34Lxx, 35Pxx, 45P05, 47A75]
45C99 None of the above, but in this section

45Dxx Volterra integral equations [See also 34A12]
45D05 Volterra integral equations [See also 34A12]
45D99 None of the above, but in this section

45Exx Singular integral equations [See also 30E20, 30E25, 44A15, 44A35]
45E05 Integral equations with kernels of Cauchy type [See also 35J15]
45E10 Integral equations of the convolution type (Abel, Picard, Toeplitz and Wiener-Hopf type) [See also 47B35]
45E99 None of the above, but in this section

45Fxx Systems of linear integral equations
45F05 Systems of nonsingular linear integral equations
45F10 Dual, triple, etc., integral and series equations
45F15 Systems of singular linear integral equations
45F99 None of the above, but in this section
45Gxx Nonlinear integral equations [See also 47H30, 47Jxx]
45G05 Singular nonlinear integral equations
45G10 Other nonlinear integral equations
45G15 Systems of nonlinear integral equations
45G99 None of the above, but in this section

45Hxx Integral equations with miscellaneous special kernels [See also 44A15]
45H05 Integral equations with miscellaneous special kernels [See also 44A15]
45H99 None of the above, but in this section

45Jxx Integro-ordinary differential equations [See also 34K05, 34K30, 47G20]
45J05 Integro-ordinary differential equations [See also 34K05, 34K30, 47G20]
45J99 None of the above, but in this section

45Kxx Integro-partial differential equations [See also 34K30, 35R09, 35R10, 47G20]
45K05 Integro-partial differential equations [See also 34K30, 35R09, 35R10, 47G20]
45K99 None of the above, but in this section

45Lxx Theoretical approximation of solutions to integral equations {For numerical analysis, see 65Rxx}
45L05 Theoretical approximation of solutions to integral equations {For numerical analysis, see 65Rxx}
45L99 None of the above, but in this section

45Mxx Qualitative behavior of solutions to integral equations
45M05 Asymptotics of solutions to integral equations
45M10 Stability theory for integral equations
45M15 Periodic solutions of integral equations
45M20 Positive solutions of integral equations
45M99 None of the above, but in this section

45Nxx Abstract integral equations, integral equations in abstract spaces
45N05 Abstract integral equations, integral equations in abstract spaces
45N99 None of the above, but in this section

45Pxx Integral operators [See also 47B38, 47G10]
45P05 Integral operators [See also 47B38, 47G10]
45P99 None of the above, but in this section

117
45Qxx Inverse problems for integral equations
45Q05 Inverse problems for integral equations
45Q99 None of the above, but in this section

45Rxx Random integral equations [See also 60H20]
45R05 Random integral equations [See also 60H20]
45R99 None of the above, but in this section

46-XX Functional analysis \{For manifolds modeled on topological linear spaces, see 57Nxx, 58Bxx\}
46-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to functional analysis
46-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to functional analysis
46-02 Research exposition (monographs, survey articles) pertaining to functional analysis
46-03 History of functional analysis [Consider also classification numbers pertaining to Section 01]
46-04 Software, source code, etc. for problems pertaining to functional analysis
46-06 Proceedings, conferences, collections, etc. pertaining to functional analysis
46-08 Computational methods for problems pertaining to functional analysis
46-11 Research data for problems pertaining to functional analysis

46Axx Topological linear spaces and related structures \{For function spaces, see 46Exx\}
46A03 General theory of locally convex spaces
46A04 Locally convex Fréchet spaces and (DF)-spaces
46A08 Barrelled spaces, bornological spaces
46A11 Spaces determined by compactness or summability properties (nuclear spaces, Schwartz spaces, Montel spaces, etc.)
46A13 Spaces defined by inductive or projective limits (LB, LF, etc.) [See also 46M40]
46A16 Not locally convex spaces (metrizable topological linear spaces, locally bounded spaces, quasi-Banach spaces, etc.)
46A17 Bornologies and related structures; Mackey convergence, etc.
46A19 Other “topological” linear spaces (convergence spaces, ranked spaces, spaces with a metric taking values in an ordered structure more general than \(\mathbb{R}\), etc.)
46A20 Duality theory for topological vector spaces
46A22 Theorems of Hahn-Banach type; extension and lifting of functionals and operators [See also 46M10]
46A25 Reflexivity and semi-reflexivity [See also 46B10]
46A30 Open mapping and closed graph theorems; completeness (including \(B_\ast\), \(B_\tau\)-completeness)
46A32 Spaces of linear operators; topological tensor products; approximation properties [See also 46B28, 46M05, 47L05, 47L20]

46A35 Summability and bases in topological vector spaces [See also 46B15]

46A40 Ordered topological linear spaces, vector lattices [See also 06F20, 46B40, 46B42]

46A45 Sequence spaces (including Köthe sequence spaces) [See also 46B45]

46A50 Compactness in topological linear spaces; angelic spaces, etc.

46A55 Convex sets in topological linear spaces; Choquet theory [See also 52A07]

46A61 Graded Fréchet spaces and tame operators

46A63 Topological invariants ((DN), (Ω), etc.) for locally convex spaces

46A70 Saks spaces and their duals (strict topologies, mixed topologies, two-norm spaces, co-Saks spaces, etc.)

46A80 Modular spaces

46A99 None of the above, but in this section

46Bxx Normed linear spaces and Banach spaces; Banach lattices {For function spaces, see 46Exx}

46B03 Isomorphic theory (including renorming) of Banach spaces

46B04 Isometric theory of Banach spaces

46B06 Asymptotic theory of Banach spaces [See also 52A23]

46B07 Local theory of Banach spaces

46B08 Ultraproduct techniques in Banach space theory [See also 46M07]

46B09 Probabilistic methods in Banach space theory [See also 60Bxx]

46B10 Duality and reflexivity in normed linear and Banach spaces [See also 46A25]

46B11 Summability and bases; functional analytic aspects of frames in Banach and Hilbert spaces [See also 46A25, 42C15]

46B20 Geometry and structure of normed linear spaces

46B22 Radon-Nikodým, Kreín-Milman and related properties [See also 46G10]

46B25 Classical Banach spaces in the general theory

46B26 Nonseparable Banach spaces

46B28 Spaces of operators; tensor products; approximation properties [See also 46A32, 46M05, 47L05, 47L20]

46B40 Ordered normed spaces [See also 46A40, 46B42]

46B42 Banach lattices [See also 46A40, 46B40]

46B45 Banach sequence spaces [See also 46A45]

46B50 Compactness in Banach (or normed) spaces

46B70 Interpolation between normed linear spaces [See also 46M35]

46B80 Nonlinear classification of Banach spaces; nonlinear quotients
46B85 Embeddings of discrete metric spaces into Banach spaces; applications in topology and computer science
[See also 05C12, 68Rxx]
46B87 Lineability in functional analysis [See also 15A03]
46B99 None of the above, but in this section

46Cxx Inner product spaces and their generalizations, Hilbert spaces {For function spaces, see 46Exx}
46C05 Hilbert and pre-Hilbert spaces: geometry and topology (including spaces with semidefinite inner product)
46C07 Hilbert subspaces (= operator ranges); complementation (Aronszajn, de Branges, etc.) [See also 46B70, 46M35]
46C15 Characterizations of Hilbert spaces
46C20 Spaces with indefinite inner product (Kreĭn spaces, Pontryagin spaces, etc.) [See also 47B50]
46C50 Generalizations of inner products (semi-inner products, partial inner products, etc.)
46C99 None of the above, but in this section

46Exx Linear function spaces and their duals [See also 30H05, 32A38, 46F05] {For function algebras, see 46J10}
46E05 Lattices of continuous, differentiable or analytic functions
46E10 Topological linear spaces of continuous, differentiable or analytic functions
46E15 Banach spaces of continuous, differentiable or analytic functions
46E20 Hilbert spaces of continuous, differentiable or analytic functions
46E22 Hilbert spaces with reproducing kernels (= (proper) functional Hilbert spaces, including de Branges-Rovnyak and other structured spaces) [See also 47B32]
46E25 Rings and algebras of continuous, differentiable or analytic functions {For Banach function algebras, see 46J10, 46J15}
46E27 Spaces of measures [See also 28A33, 46Gxx]
46E30 Spaces of measurable functions ($L^p$-spaces, Orlicz spaces, Köthe function spaces, Lorentz spaces, rearrangement invariant spaces, ideal spaces, etc.)
46E35 Sobolev spaces and other spaces of “smooth” functions, embedding theorems, trace theorems
46E36 Sobolev (and similar kinds of) spaces of functions on metric spaces; analysis on metric spaces
46E39 Sobolev (and similar kinds of) spaces of functions of discrete variables
46E40 Spaces of vector- and operator-valued functions
46E50 Spaces of differentiable or holomorphic functions on infinite-dimensional spaces [See also 46G20, 46G25, 47H60]
46E99 None of the above, but in this section
46Fxx Distributions, generalized functions, distribution spaces [See also 46T30]

46F05 Topological linear spaces of test functions, distributions and ultradistributions [See also 46E10, 46E35]

46F10 Operations with distributions and generalized functions

46F12 Integral transforms in distribution spaces [See also 42-XX, 44-XX]

46F15 Hyperfunctions, analytic functionals [See also 32A25, 32A45, 32C35, 58J15]

46F20 Distributions and ultradistributions as boundary values of analytic functions [See also 30D40, 30E25, 32A40]

46F25 Distributions on infinite-dimensional spaces [See also 58C35]

46F30 Generalized functions for nonlinear analysis (Rosinger, Colombeau, nonstandard, etc.)

46F99 None of the above, but in this section

46Gxx Measures, integration, derivative, holomorphy (all involving infinite-dimensional spaces) [See also 28-XX, 46Txx]

46G05 Derivatives of functions in infinite-dimensional spaces [See also 46T20, 58C20, 58C25]

46G10 Vector-valued measures and integration [See also 28Bxx, 46B22]

46G12 Measures and integration on abstract linear spaces [See also 28C20, 46T12]

46G15 Functional analytic lifting theory [See also 28A51]

46G20 Infinite-dimensional holomorphy [See also 32-XX, 46E50, 46T25, 58B12, 58C10]

46G25 (Spaces of) multilinear mappings, polynomials [See also 46E50, 46G20, 47H60]

46G99 None of the above, but in this section

46Hxx Topological algebras, normed rings and algebras, Banach algebras {For group algebras, convolution algebras and measure algebras, see 43A10, 43A20}

46H05 General theory of topological algebras

46H10 Ideals and subalgebras

46H15 Representations of topological algebras

46H20 Structure, classification of topological algebras

46H25 Normed modules and Banach modules, topological modules (if not placed in 13-XX or 16-XX)

46H30 Functional calculus in topological algebras [See also 47A60]

46H35 Topological algebras of operators [See mainly 47Lxx]

46H40 Automatic continuity

46H70 Nonassociative topological algebras [See also 46K70, 46L70]

46H99 None of the above, but in this section
### 46Jxx Commutative Banach algebras and commutative topological algebras [See also 46E25]

- **46J05** General theory of commutative topological algebras
- **46J10** Banach algebras of continuous functions, function algebras [See also 46E25]
- **46J15** Banach algebras of differentiable or analytic functions, $H^p$-spaces [See also 30H10, 32A35, 32A37, 32A38, 42B30]
- **46J20** Ideals, maximal ideals, boundaries
- **46J25** Representations of commutative topological algebras
- **46J30** Subalgebras of commutative topological algebras
- **46J40** Structure and classification of commutative topological algebras
- **46J45** Radical Banach algebras
- **46J99** None of the above, but in this section

### 46Kxx Topological (rings and) algebras with an involution [See also 16W10]

- **46K05** General theory of topological algebras with involution
- **46K10** Representations of topological algebras with involution
- **46K15** Hilbert algebras
- **46K50** Nonselfadjoint (sub)algebras in algebras with involution
- **46K70** Nonassociative topological algebras with an involution [See also 46H70, 46L70]
- **46K99** None of the above, but in this section

### 46Lxx Selfadjoint operator algebras ($C^*$-algebras, von Neumann ($W^*$-) algebras, etc.) [See also 22D25, 47Lxx]

- **46L05** General theory of $C^*$-algebras
- **46L06** Tensor products of $C^*$-algebras
- **46L07** Operator spaces and completely bounded maps [See also 47L25]
- **46L08** $C^*$-modules
- **46L09** Free products of $C^*$-algebras
- **46L10** General theory of von Neumann algebras
- **46L30** States of selfadjoint operator algebras
- **46L35** Classifications of $C^*$-algebras
- **46L36** Classification of factors
- **46L37** Subfactors and their classification
- **46L40** Automorphisms of selfadjoint operator algebras
- **46L45** Decomposition theory for $C^*$-algebras
46L51 Noncommutative measure and integration
46L52 Noncommutative function spaces
46L53 Noncommutative probability and statistics
46L54 Free probability and free operator algebras
46L55 Noncommutative dynamical systems [See also 28Dxx, 37Kxx, 37Lxx, 37A55]
46L57 Derivations, dissipations and positive semigroups in $C^*$-algebras
46L60 Applications of selfadjoint operator algebras to physics [See also 46N50, 46N55, 47L90, 81T05, 82B10, 82C10]
46L65 Quantizations, deformations for selfadjoint operator algebras
46L67 Quantum groups (operator algebraic aspects)
46L70 Nonassociative selfadjoint operator algebras [See also 46H70, 46K70]
46L80 $K$-theory and operator algebras (including cyclic theory) [See also 18F25, 19Kxx, 46M20, 55Rxx, 58J22]
46L85 Noncommutative topology [See also 58B32, 58B34, 58J22]
46L87 Noncommutative differential geometry [See also 58B32, 58B34, 58J22]
46L89 Other “noncommutative” mathematics based on $C^*$-algebra theory [See also 58B32, 58B34, 58J22]
46L99 None of the above, but in this section

46Mxx Methods of category theory in functional analysis [See also 18-XX]
46M05 Tensor products in functional analysis [See also 46A32, 46B28, 47A80]
46M07 Ultraproducts in functional analysis [See also 46B08, 46S20]
46M10 Projective and injective objects in functional analysis [See also 46A22]
46M15 Categories, functors in functional analysis {For $K$-theory, Ext, etc., see 19K33, 46L80, 46M18, 46M20}
46M18 Homological methods in functional analysis (exact sequences, right inverses, lifting, etc.)
46M20 Methods of algebraic topology in functional analysis (cohomology, sheaf and bundle theory, etc.) [See also 14F06, 18Fx, 19Kxx, 32Cxx, 32Lxx, 46L80, 46M15, 46M18, 55Rxx]
46M35 Abstract interpolation of topological vector spaces [See also 46B70]
46M40 Inductive and projective limits in functional analysis [See also 46A13]
46M99 None of the above, but in this section

46Nxx Miscellaneous applications of functional analysis [See also 47Nxx]
46N10 Applications of functional analysis in optimization, convex analysis, mathematical programming, economics
46N20 Applications of functional analysis to differential and integral equations
46N30 Applications of functional analysis in probability theory and statistics
46N40 Applications of functional analysis in numerical analysis [See also 65Jxx]
46N50 Applications of functional analysis in quantum physics
46N55 Applications of functional analysis in statistical physics
46N60 Applications of functional analysis in biology and other sciences
46N99 None of the above, but in this section
46Sxx Other (nonclassical) types of functional analysis [See also 47Sxx]

46S05 Quaternionic functional analysis

46S10 Functional analysis over fields other than \( \mathbb{R} \) or \( \mathbb{C} \) or the quaternions; non-Archimedean functional analysis [See also 12J25, 32P05]

46S20 Nonstandard functional analysis [See also 03H05]

46S30 Constructive functional analysis [See also 03F60]

46S40 Fuzzy functional analysis [See also 03E72]

46S50 Functional analysis in probabilistic metric linear spaces

46S60 Functional analysis on superspaces (supermanifolds) or graded spaces [See also 58A50, 58C50]

46S99 None of the above, but in this section

46Txx Nonlinear functional analysis [See also 47Hxx, 47Jxx, 58Cxx, 58Dxx]

46T05 Infinite-dimensional manifolds [See also 53Axx, 57N20, 58Bxx, 58Dxx]

46T10 Manifolds of mappings

46T12 Measure (Gaussian, cylindrical, etc.) and integrals (Feynman, path, Fresnel, etc.) on manifolds [See also 28Cxx, 46G12, 60-XX]

46T20 Continuous and differentiable maps in nonlinear functional analysis [See also 46G05]

46T25 Holomorphic maps in nonlinear functional analysis [See also 46G20]

46T30 Distributions and generalized functions on nonlinear spaces [See also 46Fxx]

46T99 None of the above, but in this section

47-XX Operator theory

47-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to operator theory

47-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to operator theory

47-02 Research exposition (monographs, survey articles) pertaining to operator theory

47-03 History of operator theory [Consider also classification numbers pertaining to Section 01]

47-04 Software, source code, etc. for problems pertaining to operator theory

47-06 Proceedings, conferences, collections, etc. pertaining to operator theory

47-08 Computational methods for problems pertaining to operator theory

47-11 Research data for problems pertaining to operator theory
47Axx General theory of linear operators

47A05 General (adjoints, conjugates, products, inverses, domains, ranges, etc.)

47A06 Linear relations (multivalued linear operators)

47A07 Forms (bilinear, sesquilinear, multilinear)

47A08 Operator matrices [See also 47A13]

47A10 Spectrum, resolvent

47A11 Local spectral properties of linear operators

47A12 Numerical range, numerical radius

47A13 Several-variable operator theory (spectral, Fredholm, etc.)

47A15 Invariant subspaces of linear operators [See also 47A46]

47A16 Cyclic vectors, hypercyclic and chaotic operators

47A20 Dilations, extensions, compressions of linear operators

47A25 Spectral sets of linear operators

47A30 Norms (inequalities, more than one norm, etc.) of linear operators

47A35 Ergodic theory of linear operators [See also 28Dxx, 37Axx]

47A40 Scattering theory of linear operators [See also 34L25, 35P25, 37K15, 58J50, 81Uxx]

47A45 Canonical models for contractions and nonselfadjoint linear operators

47A46 Chains (nests) of projections or of invariant subspaces, integrals along chains, etc.

47A48 Operator colligations (= nodes), vessels, linear systems, characteristic functions, realizations, etc.

47A50 Equations and inequalities involving linear operators, with vector unknowns

47A52 Linear operators and ill-posed problems, regularization [See also 35R25, 47J06, 65F22, 65J20, 65L08, 65M30, 65R30]

47A53 (Semi-) Fredholm operators; index theories [See also 58B15, 58J20]

47A55 Perturbation theory of linear operators [See also 47H14, 58J37, 70H09, 81Q15]

47A56 Functions whose values are linear operators (operator- and matrix-valued functions, etc., including analytic and meromorphic ones)

47A57 Linear operator methods in interpolation, moment and extension problems [See also 30E05, 42A70, 42A82, 44A60]

47A58 Linear operator approximation theory

47A60 Functional calculus for linear operators

47A62 Equations involving linear operators, with operator unknowns

47A63 Linear operator inequalities

47A64 Operator means involving linear operators, shorted linear operators, etc.

47A65 Structure theory of linear operators
47A66 Quasitriangular and nonquasitriangular, quasidiagonal and nonquasidiagonal linear operators
47A67 Representation theory of linear operators
47A68 Factorization theory (including Wiener-Hopf and spectral factorizations) of linear operators
47A70 (Generalized) eigenfunction expansions of linear operators; rigged Hilbert spaces
47A75 Eigenvalue problems for linear operators [See also 47J10, 49R05]
47A80 Tensor products of linear operators [See also 46M05]
47A99 None of the above, but in this section

47Bxx Special classes of linear operators

47B01 Operators on Banach spaces
47B02 Operators on Hilbert spaces (general)
47B06 Riesz operators; eigenvalue distributions; approximation numbers, s-numbers, Kolmogorov numbers, entropy numbers, etc. of operators
47B07 Linear operators defined by compactness properties
47B10 Linear operators belonging to operator ideals (nuclear, p-summing, in the Schatten-von Neumann classes, etc.) [See also 47L20]
47B12 Sectorial operators
47B13 Cowen-Douglas operators
47B15 Hermitian and normal operators (spectral measures, functional calculus, etc.)
47B20 Subnormal operators, hyponormal operators, etc.
47B25 Linear symmetric and selfadjoint operators (unbounded)
47B28 Nonspectral operators [See also 47A45, 81Q12]
47B32 Linear operators in reproducing-kernel Hilbert spaces (including de Branges, de Branges-Rovnyak, and other structured spaces) [See also 46E22]
47B33 Linear composition operators
47B34 Kernel operators
47B35 Toeplitz operators, Hankel operators, Wiener-Hopf operators {For other integral operators, see also 45P05, 47G10} [See also 32A25, 32M15]
47B36 Jacobi (tridiagonal) operators (matrices) and generalizations
47B37 Linear operators on special spaces (weighted shifts, operators on sequence spaces, etc.)
47B38 Linear operators on function spaces (general)
47B39 Linear difference operators [See also 39A70]
47B40 Spectral operators, decomposable operators, well-bounded operators, etc.
47B44 Linear accretive operators, dissipative operators, etc.
47B47 Commutators, derivations, elementary operators, etc.
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>47B48</td>
<td>Linear operators on Banach algebras</td>
</tr>
<tr>
<td>47B49</td>
<td>Transformers, preservers (linear operators on spaces of linear operators)</td>
</tr>
<tr>
<td>47B50</td>
<td>Linear operators on spaces with an indefinite metric [See also 46C20]</td>
</tr>
<tr>
<td>47B60</td>
<td>Linear operators on ordered spaces</td>
</tr>
<tr>
<td>47B65</td>
<td>Positive linear operators and order-bounded operators</td>
</tr>
<tr>
<td>47B80</td>
<td>Random linear operators [See also 47H40, 60H25]</td>
</tr>
<tr>
<td>47B90</td>
<td>Operator theory and harmonic analysis [See also 42-XX, 43-XX, 44-XX]</td>
</tr>
<tr>
<td>47B91</td>
<td>Operators on complex function spaces</td>
</tr>
<tr>
<td>47B92</td>
<td>Operators on real function spaces</td>
</tr>
<tr>
<td>47B93</td>
<td>Operators arising in mathematical physics</td>
</tr>
<tr>
<td>47B99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

**47Cxx Individual linear operators as elements of algebraic systems**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>47C05</td>
<td>Linear operators in algebras</td>
</tr>
<tr>
<td>47C10</td>
<td>Linear operators in *-algebras</td>
</tr>
<tr>
<td>47C15</td>
<td>Linear operators in C*- or von Neumann algebras</td>
</tr>
<tr>
<td>47C99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

**47Dxx Groups and semigroups of linear operators, their generalizations and applications**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>47D03</td>
<td>Groups and semigroups of linear operators [See also 20M20] {For nonlinear operators, see 47H20}</td>
</tr>
<tr>
<td>47D06</td>
<td>One-parameter semigroups and linear evolution equations [See also 34G10, 34K30]</td>
</tr>
<tr>
<td>47D07</td>
<td>Markov semigroups and applications to diffusion processes {For Markov processes, see 60Jxx}</td>
</tr>
<tr>
<td>47D08</td>
<td>Schrödinger and Feynman-Kac semigroups</td>
</tr>
<tr>
<td>47D09</td>
<td>Operator sine and cosine functions and higher-order Cauchy problems [See also 34G10]</td>
</tr>
<tr>
<td>47D60</td>
<td>C-semigroups, regularized semigroups</td>
</tr>
<tr>
<td>47D62</td>
<td>Integrated semigroups</td>
</tr>
<tr>
<td>47D99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

**47Exx Ordinary differential operators [See also 34Bxx, 34Lxx]**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>47E05</td>
<td>Ordinary differential operators (should also be assigned at least one other classification number in Section 47) [See also 34Bxx, 34Lxx]</td>
</tr>
<tr>
<td>47E07</td>
<td>Functional-differential and differential-difference operators [See also 34K08]</td>
</tr>
<tr>
<td>47E99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
47Fxx Partial differential operators [See also 35Pxx, 58Jxx]

47F05 Partial differential operators (should also be assigned at least one other classification number in Section 47) [See also 35Pxx, 58Jxx]

47F10 Elliptic operators and their generalizations {For elliptic complexes, see 58J10}

47F99 None of the above, but in this section

47Gxx Integral, integro-differential, and pseudodifferential operators [See also 58Jxx]

47G10 Integral operators [See also 45P05]

47G20 Integro-differential operators [See also 34K30, 35R09, 35R10, 45Jxx, 45Kxx]

47G30 Pseudodifferential operators [See also 35Sxx, 58Jxx]

47G40 Potential operators [See also 31-XX]

47G99 None of the above, but in this section

47Hxx Nonlinear operators and their properties {For global and geometric aspects, see 49J53, 58-XX, especially 58Cxx}

47H04 Set-valued operators [See also 28B20, 54C60, 58C06]

47H05 Monotone operators and generalizations

47H06 Nonlinear accretive operators, dissipative operators, etc.

47H07 Monotone and positive operators on ordered Banach spaces or other ordered topological vector spaces

47H08 Measures of noncompactness and condensing mappings, K-set contractions, etc.

47H09 Contraction-type mappings, nonexpansive mappings, A-proper mappings, etc.

47H10 Fixed-point theorems [See also 37C25, 54H25, 55M20, 58C30]

47H11 Degree theory for nonlinear operators [See also 55M25, 58C30]

47H14 Perturbations of nonlinear operators [See also 47A55, 58J37, 70H09, 70K60, 81Q15]

47H20 Semigroups of nonlinear operators [See also 37L05, 47J35, 54H15, 58D07]

47H25 Nonlinear ergodic theorems [See also 28Dxx, 37Axx, 47A35]

47H30 Particular nonlinear operators (superposition, Hammerstein, Nemytskii, Uryson, etc.) [See also 45Gxx, 45P05]

47H40 Random nonlinear operators [See also 47B80, 60H25]

47H60 Multilinear and polynomial operators [See also 46G25]

47H99 None of the above, but in this section

128
47Jxx Equations and inequalities involving nonlinear operators [See also 46Txx] {For global and geometric aspects, see 58-XX}

47J05 Equations involving nonlinear operators (general) [See also 47H10, 47J25]

47J06 Nonlinear ill-posed problems [See also 35R25, 47A52, 65F22, 65J20, 65L08, 65M30, 65R30]

47J07 Abstract inverse mapping and implicit function theorems involving nonlinear operators [See also 46T20, 58C15]

47J10 Nonlinear spectral theory, nonlinear eigenvalue problems [See also 49R05]

47J15 Abstract bifurcation theory involving nonlinear operators [See also 34C23, 37Gxx, 58E07, 58E09]

47J20 Variational and other types of inequalities involving nonlinear operators (general) [See also 49J40]

47J22 Variational and other types of inclusions [See also 34A60, 49J21, 49K21]

47J25 Iterative procedures involving nonlinear operators [See also 47J26, 65J15]

47J26 Fixed-point iterations [See also 47J25]

47J30 Variational methods involving nonlinear operators [See also 58Exx]

47J35 Nonlinear evolution equations [See also 34G20, 35K90, 35L90, 35Qxx, 35R20, 37Kxx, 37Lxx, 47H20, 58D25]

47J40 Equations with nonlinear hysteresis operators [See also 34C55, 74N30]

47J99 None of the above, but in this section

47Lxx Linear spaces and algebras of operators [See also 46Lxx]

47L05 Linear spaces of operators [See also 46A32, 46B28]

47L07 Convex sets and cones of operators [See also 46A55]

47L10 Algebras of operators on Banach spaces and other topological linear spaces

47L15 Operator algebras with symbol structure

47L20 Operator ideals [See also 47B10]

47L22 Ideals of polynomials and of multilinear mappings in operator theory

47L25 Operator spaces (= matricially normed spaces) [See also 46L07]

47L30 Abstract operator algebras on Hilbert spaces

47L35 Nest algebras, CSL algebras

47L40 Limit algebras, subalgebras of $C^*$-algebras

47L45 Dual algebras; weakly closed singly generated operator algebras

47L50 Dual spaces of operator algebras

47L55 Representations of (nonselfadjoint) operator algebras

47L60 Algebras of unbounded operators; partial algebras of operators

47L65 Crossed product algebras (analytic crossed products)

47L70 Nonassociative nonselfadjoint operator algebras
47L75 Other nonselfadjoint operator algebras
47L80 Algebras of specific types of operators (Toeplitz, integral, pseudodifferential, etc.)
47L90 Applications of operator algebras to the sciences
47L99 None of the above, but in this section

47Nxx Miscellaneous applications of operator theory [See also 46Nxx]
47N10 Applications of operator theory in optimization, convex analysis, mathematical programming, economics
47N20 Applications of operator theory to differential and integral equations
47N30 Applications of operator theory in probability theory and statistics
47N40 Applications of operator theory in numerical analysis [See also 65Jxx]
47N50 Applications of operator theory in the physical sciences
47N60 Applications of operator theory in chemistry and life sciences
47N70 Applications of operator theory in systems, signals, circuits, and control theory
47N99 None of the above, but in this section

47Sxx Other (nonclassical) types of operator theory [See also 46Sxx]
47S05 Quaternionic operator theory
47S10 Operator theory over fields other than \( \mathbb{R} \), \( \mathbb{C} \) or the quaternions; non-Archimedean operator theory
47S20 Nonstandard operator theory [See also 03H05]
47S30 Constructive operator theory [See also 03F60]
47S40 Fuzzy operator theory [See also 03E72]
47S50 Operator theory in probabilistic metric linear spaces [See also 54E70]
47S99 None of the above, but in this section

49-XX Calculus of variations and optimal control; optimization [See also 34H05, 34K35, 65Kxx, 90Cxx, 93-XX]
49-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to calculus of variations and optimal control
49-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to calculus of variations and optimal control
49-02 Research exposition (monographs, survey articles) pertaining to calculus of variations and optimal control
49-03 History of calculus of variations and optimal control [Consider also classification numbers pertaining to Section 01]
49-04 Software, source code, etc. for problems pertaining to calculus of variations and optimal control
49-06 Proceedings, conferences, collections, etc. pertaining to calculus of variations and optimal control
49-11 Research data for problems pertaining to calculus of variations and optimal control
49Jxx Existence theories in calculus of variations and optimal control

49J05 Existence theories for free problems in one independent variable

49J10 Existence theories for free problems in two or more independent variables

49J15 Existence theories for optimal control problems involving ordinary differential equations

49J20 Existence theories for optimal control problems involving partial differential equations

49J21 Existence theories for optimal control problems involving relations other than differential equations

49J27 Existence theories for problems in abstract spaces [See also 90C48, 93C25]

49J30 Existence of optimal solutions belonging to restricted classes (Lipschitz controls, bang-bang controls, etc.)

49J35 Existence of solutions for minimax problems

49J40 Variational inequalities [See also 47J20]

49J45 Methods involving semicontinuity and convergence; relaxation

49J50 Fréchet and Gateaux differentiability in optimization [See also 46G05, 58C20]

49J52 Nonsmooth analysis [See also 46G05, 58C50, 90C56]

49J53 Set-valued and variational analysis [See also 28B20, 47H04, 54C60, 58C06]

49J55 Existence of optimal solutions to problems involving randomness [See also 93E20]

49J99 None of the above, but in this section

49Kxx Optimality conditions

49K05 Optimality conditions for free problems in one independent variable

49K10 Optimality conditions for free problems in two or more independent variables

49K15 Optimality conditions for problems involving ordinary differential equations

49K20 Optimality conditions for problems involving partial differential equations

49K21 Optimality conditions for problems involving relations other than differential equations

49K27 Optimality conditions for problems in abstract spaces [See also 90C48, 93C25]

49K30 Optimality conditions for solutions belonging to restricted classes (Lipschitz controls, bang-bang controls, etc.)

49K35 Optimality conditions for minimax problems

49K40 Sensitivity, stability, well-posedness [See also 90C31]

49K45 Optimality conditions for problems involving randomness [See also 93E20]

49K99 None of the above, but in this section

49Lxx Hamilton-Jacobi theories [See also 70H20, 35F21]

49L05 Hamilton-Jacobi equations in optimal control and differential games

49L20 Dynamic programming in optimal control and differential games

49L25 Viscosity solutions to Hamilton-Jacobi equations in optimal control and differential games

49L99 None of the above, but in this section
49Mxx Numerical methods in optimal control [See also 65Kxx, 90-08, 90Cxx]

- 49M05 Numerical methods based on necessary conditions
- 49M15 Newton-type methods [See also 90C53]
- 49M20 Numerical methods of relaxation type
- 49M25 Discrete approximations in optimal control
- 49M27 Decomposition methods
- 49M29 Numerical methods involving duality
- 49M37 Numerical methods based on nonlinear programming [See also 65Kxx, 90C30]
- 49M40 PDE constrained optimization
- 49M99 None of the above, but in this section

49Nxx Miscellaneous topics in calculus of variations and optimal control

- 49N05 Linear optimal control problems [See also 93C05]
- 49N10 Linear-quadratic optimal control problems
- 49N15 Duality theory (optimization) [See also 90C46]
- 49N20 Periodic optimal control problems
- 49N25 Impulsive optimal control problems
- 49N30 Problems with incomplete information (optimization) [See also 93C41]
- 49N35 Optimal feedback synthesis [See also 93B52]
- 49N45 Inverse problems in optimal control
- 49N60 Regularity of solutions in optimal control
- 49N70 Differential games and control [See also 91A23]
- 49N75 Pursuit and evasion games [See also 91A24]
- 49N80 Mean field games and control [See also 91A16]
- 49N90 Applications of optimal control and differential games [See also 90C90, 91A80, 93C95]
- 49N99 None of the above, but in this section

49Qxx Manifolds and measure-geometric topics [See also 58Exx]

- 49Q05 Minimal surfaces and optimization [See also 53A10, 58E12]
- 49Q10 Optimization of shapes other than minimal surfaces [See also 90C90]
- 49Q12 Sensitivity analysis for optimization problems on manifolds
- 49Q15 Geometric measure and integration theory, integral and normal currents in optimization [See also 28A75, 32C30, 58A25, 58C35]
- 49Q20 Variational problems in a geometric measure-theoretic setting
- 49Q25 Optimal transportation [See also 90B06]
- 49Q99 None of the above, but in this section
49Rxx Variational methods for eigenvalues of operators (should also be assigned at least one other classification number in Section 49) [See also 47A75]

49R05 Variational methods for eigenvalues of operators (should also be assigned at least one other classification number in Section 49) [See also 47A75]

49R99 None of the above, but in this section

49Sxx Variational principles of physics (should also be assigned at least one other classification number in Section 49)

49S05 Variational principles of physics (should also be assigned at least one other classification number in Section 49)

49S99 None of the above, but in this section

51-XX Geometry \{For algebraic geometry, see 14-XX; for differential geometry, see 53-XX\}

51-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to geometry

51-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to geometry

51-02 Research exposition (monographs, survey articles) pertaining to geometry

51-03 History of geometry [Consider also classification numbers pertaining to Section 01]

51-04 Software, source code, etc. for problems pertaining to geometry

51-06 Proceedings, conferences, collections, etc. pertaining to geometry

51-08 Computational methods for problems pertaining to geometry

51-11 Research data for problems pertaining to geometry

51Axx Linear incidence geometry

51A05 General theory of linear incidence geometry and projective geometries

51A10 Homomorphism, automorphism and dualities in linear incidence geometry

51A15 Linear incidence geometric structures with parallelism

51A20 Configuration theorems in linear incidence geometry

51A25 Algebraization in linear incidence geometry [See also 12Kxx, 20N05]

51A30 Desarguesian and Pappian geometries

51A35 Non-Desarguesian affine and projective planes

51A40 Translation planes and spreads in linear incidence geometry

51A45 Incidence structures embeddable into projective geometries

51A50 Polar geometry, symplectic spaces, orthogonal spaces

51A99 None of the above, but in this section
51Bxx Nonlinear incidence geometry
51B05 General theory of nonlinear incidence geometry
51B10 Möbius geometries
51B15 Laguerre geometries
51B20 Minkowski geometries in nonlinear incidence geometry
51B25 Lie geometries in nonlinear incidence geometry
51B99 None of the above, but in this section

51Cxx Ring geometry (Hjelmslev, Barbilian, etc.)
51C05 Ring geometry (Hjelmslev, Barbilian, etc.)
51C99 None of the above, but in this section

51Dxx Geometric closure systems
51D05 Abstract (Maeda) geometries
51D10 Abstract geometries with exchange axiom
51D15 Abstract geometries with parallelism
51D20 Combinatorial geometries and geometric closure systems [See also 05B25, 05B35]
51D25 Lattices of subspaces and geometric closure systems [See also 05B35]
51D30 Continuous geometries, geometric closure systems and related topics [See also 06Cxx]
51D99 None of the above, but in this section

51Exx Finite geometry and special incidence structures
51E05 General block designs in finite geometry [See also 05B05]
51E10 Steiner systems in finite geometry [See also 05B05]
51E12 Generalized quadrangles and generalized polygons in finite geometry
51E14 Finite partial geometries (general), nets, partial spreads
51E15 Finite affine and projective planes (geometric aspects)
51E20 Combinatorial structures in finite projective spaces [See also 05Bxx]
51E21 Blocking sets, ovals, $k$-arcs
51E22 Linear codes and caps in Galois spaces [See also 94B05]
51E23 Spreads and packing problems in finite geometry
51E24 Buildings and the geometry of diagrams
51E25 Other finite nonlinear geometries
51E26 Other finite linear geometries
51E30 Other finite incidence structures (geometric aspects) [See also 05B30]
51E99 None of the above, but in this section
51Fxx Metric geometry

51F05 Absolute planes in metric geometry

51F10 Absolute spaces in metric geometry

51F15 Reflection groups, reflection geometries [See also 20H10, 20H15] {For Coxeter groups, see 20F55}

51F20 Congruence and orthogonality in metric geometry [See also 20H05]

51F25 Orthogonal and unitary groups in metric geometry [See also 20H05]

51F30 Lipschitz and coarse geometry of metric spaces [See also 53C23]

51F99 None of the above, but in this section

51Gxx Ordered geometries (ordered incidence structures, etc.)

51G05 Ordered geometries (ordered incidence structures, etc.)

51G99 None of the above, but in this section

51Hxx Topological geometry

51H05 General theory of topological geometry

51H10 Topological linear incidence structures

51H15 Topological nonlinear incidence structures

51H20 Topological geometries on manifolds [See also 57-XX]

51H25 Geometries with differentiable structure [See also 53Cxx, especially 53C70]

51H30 Geometries with algebraic manifold structure [See also 14-XX]

51H99 None of the above, but in this section

51Jxx Incidence groups

51J05 General theory of incidence groups

51J10 Projective incidence groups

51J15 Kinematic spaces

51J20 Representation by near-fields and near-algebras [See also 12K05, 16Y30]

51J99 None of the above, but in this section

51Kxx Distance geometry

51K05 General theory of distance geometry

51K10 Synthetic differential geometry

51K99 None of the above, but in this section
51Lxx Geometric order structures [See also 53C75]
51L05 Geometry of orders of nondifferentiable curves
51L10 Directly differentiable curves in geometric order structures
51L15 $\ n$-vertex theorems via direct methods
51L20 Geometry of orders of surfaces
51L99 None of the above, but in this section

51Mxx Real and complex geometry
51M04 Elementary problems in Euclidean geometries
51M05 Euclidean geometries (general) and generalizations
51M09 Elementary problems in hyperbolic and elliptic geometries
51M10 Hyperbolic and elliptic geometries (general) and generalizations
51M15 Geometric constructions in real or complex geometry
51M16 Inequalities and extremum problems in real or complex geometry {For convex problems, see 52A40}
51M20 Polyhedra and polytopes; regular figures, division of spaces [See also 51F15]
51M25 Length, area and volume in real or complex geometry [See also 26B15]
51M30 Line geometries and their generalizations [See also 53A25]
51M35 Synthetic treatment of fundamental manifolds in projective geometries (Grassmannians, Veronesians and their generalizations) [See also 14M15]
51M99 None of the above, but in this section

51Nxx Analytic and descriptive geometry
51N05 Descriptive geometry [See also 65D17, 68U07]
51N10 Affine analytic geometry
51N15 Projective analytic geometry
51N20 Euclidean analytic geometry
51N25 Analytic geometry with other transformation groups
51N30 Geometry of classical groups [See also 14L35, 20Gxx]
51N35 Questions of classical algebraic geometry [See also 14Nxx]
51N99 None of the above, but in this section

51Pxx Classical or axiomatic geometry and physics (should also be assigned at least one other classification number from Sections 70–86)
51P05 Classical or axiomatic geometry and physics (should also be assigned at least one other classification number from Sections 70–86)
51P99 None of the above, but in this section
52-XX Convex and discrete geometry

52-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to convex and discrete geometry

52-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to convex and discrete geometry

52-02 Research exposition (monographs, survey articles) pertaining to convex and discrete geometry

52-03 History of convex and discrete geometry [Consider also classification numbers pertaining to Section 01]

52-04 Software, source code, etc. for problems pertaining to convex and discrete geometry

52-06 Proceedings, conferences, collections, etc. pertaining to convex and discrete geometry

52-08 Computational methods for problems pertaining to convex and discrete geometry

52-11 Research data for problems pertaining to convex and discrete geometry

52Axx General convexity

52A01 Axiomatic and generalized convexity

52A05 Convex sets without dimension restrictions (aspects of convex geometry)

52A07 Convex sets in topological vector spaces (aspects of convex geometry) [See also 46A55]

52A10 Convex sets in 2 dimensions (including convex curves) [See also 53A04]

52A15 Convex sets in 3 dimensions (including convex surfaces) [See also 53A05, 53C45]

52A20 Convex sets in n dimensions (including convex hypersurfaces) [See also 53A07, 53C45]

52A21 Convexity and finite-dimensional Banach spaces (including special norms, zonoids, etc.) (aspects of convex geometry) [See also 46Bxx]

52A22 Random convex sets and integral geometry (aspects of convex geometry) [See also 53C65, 60D05]

52A23 Asymptotic theory of convex bodies [See also 46B06]

52A27 Approximation by convex sets

52A30 Variants of convex sets (star-shaped, (m, n)-convex, etc.)

52A35 Helly-type theorems and geometric transversal theory

52A37 Other problems of combinatorial convexity

52A38 Length, area, volume and convex sets (aspects of convex geometry) [See also 26B15, 28A75, 49Q20]

52A39 Mixed volumes and related topics in convex geometry

52A40 Inequalities and extremum problems involving convexity in convex geometry

52A41 Convex functions and convex programs in convex geometry [See also 26B25, 90C25]

52A55 Spherical and hyperbolic convexity

52A99 None of the above, but in this section
52Bxx Polytopes and polyhedra

52B05 Combinatorial properties of polytopes and polyhedra (number of faces, shortest paths, etc.) [See also 05Cxx]

52B10 Three-dimensional polytopes

52B11 n-dimensional polytopes

52B12 Special polytopes (linear programming, centrally symmetric, etc.)

52B15 Symmetry properties of polytopes

52B20 Lattice polytopes in convex geometry (including relations with commutative algebra and algebraic geometry) [See also 06A11, 13F20, 13F55, 13Hxx, 52C05, 52C07]

52B22 Shellability for polytopes and polyhedra

52B35 Gale and other diagrams

52B40 Matroids in convex geometry (realizations in the context of convex polytopes, convexity in combinatorial structures, etc.) [See also 05B35, 52Cxx]

52B45 Dissections and valuations (Hilbert’s third problem, etc.)

52B55 Computational aspects related to convexity {For computational methods, see 52-08; for computational geometry and algorithms, see 68Q25, 68U05; for numerical algorithms, see 65Yxx} [See also 68Uxx]

52B60 Isoperimetric problems for polytopes

52B70 Polyhedral manifolds

52B99 None of the above, but in this section

52Cxx Discrete geometry

52C05 Lattices and convex bodies in 2 dimensions (aspects of discrete geometry) [See also 11H06, 11H31, 11P21]

52C07 Lattices and convex bodies in n dimensions (aspects of discrete geometry) [See also 11H06, 11H31, 11P21]

52C10 Erdős problems and related topics of discrete geometry [See also 11Hxx]

52C15 Packing and covering in 2 dimensions (aspects of discrete geometry) [See also 05B40, 11H31]

52C17 Packing and covering in n dimensions (aspects of discrete geometry) [See also 05B40, 11H31]

52C20 Tilings in 2 dimensions (aspects of discrete geometry) [See also 05B45, 51M20]

52C22 Tilings in n dimensions (aspects of discrete geometry) [See also 05B45, 51M20]

52C23 Quasicrystals and aperiodic tilings in discrete geometry

52C25 Rigidity and flexibility of structures (aspects of discrete geometry) [See also 70B15]

52C26 Circle packings and discrete conformal geometry

52C30 Planar arrangements of lines and pseudolines (aspects of discrete geometry)

52C35 Arrangements of points, flats, hyperplanes (aspects of discrete geometry) [See also 14N20, 32S22]

52C40 Oriented matroids in discrete geometry

52C45 Combinatorial complexity of geometric structures [See also 68U05]

52C99 None of the above, but in this section

138
53-XX Differential geometry {For differential topology, see 57Rxx; for foundational questions of differentiable manifolds, see 58Axx}

53-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to differential geometry
53-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to differential geometry
53-02 Research exposition (monographs, survey articles) pertaining to differential geometry
53-03 History of differential geometry [Consider also classification numbers pertaining to Section 01]
53-04 Software, source code, etc. for problems pertaining to differential geometry
53-06 Proceedings, conferences, collections, etc. pertaining to differential geometry
53-08 Computational methods for problems pertaining to differential geometry
53-11 Research data for problems pertaining to differential geometry

53Axx Classical differential geometry

53A04 Curves in Euclidean and related spaces
53A05 Surfaces in Euclidean and related spaces
53A07 Higher-dimensional and -codimensional surfaces in Euclidean and related $n$-spaces
53A10 Minimal surfaces in differential geometry, surfaces with prescribed mean curvature [See also 49Q05, 49Q10, 53C42]
53A15 Affine differential geometry
53A17 Differential geometric aspects in kinematics
53A20 Projective differential geometry
53A25 Differential line geometry
53A30 Differential geometry of submanifolds of Möbius space
53A35 Non-Euclidean differential geometry
53A40 Other special differential geometries
53A45 Differential geometric aspects in vector and tensor analysis
53A55 Differential invariants (local theory), geometric objects
53A60 Differential geometry of webs [See also 14C21, 20N05]
53A70 Discrete differential geometry
53A99 None of the above, but in this section
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>53Bxx</td>
<td>Local differential geometry</td>
</tr>
<tr>
<td>53B05</td>
<td>Linear and affine connections</td>
</tr>
<tr>
<td>53B10</td>
<td>Projective connections</td>
</tr>
<tr>
<td>53B12</td>
<td>Differential geometric aspects of statistical manifolds and information geometry</td>
</tr>
<tr>
<td>53B15</td>
<td>Other connections</td>
</tr>
<tr>
<td>53B20</td>
<td>Local Riemannian geometry</td>
</tr>
<tr>
<td>53B21</td>
<td>Methods of local Riemannian geometry</td>
</tr>
<tr>
<td>53B25</td>
<td>Local submanifolds [See also 53C40]</td>
</tr>
<tr>
<td>53B30</td>
<td>Local differential geometry of Lorentz metrics, indefinite metrics</td>
</tr>
<tr>
<td>53B35</td>
<td>Local differential geometry of Hermitian and Kählerian structures [See also 32Qxx]</td>
</tr>
<tr>
<td>53B40</td>
<td>Local differential geometry of Finsler spaces and generalizations (areal metrics)</td>
</tr>
<tr>
<td>53B50</td>
<td>Applications of local differential geometry to the sciences</td>
</tr>
<tr>
<td>53B99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>53Cxx</td>
<td>Global differential geometry [See also 51H25, 58-XX] {For related bundle theory, see 55Rxx, 57Rxx}</td>
</tr>
<tr>
<td>53C05</td>
<td>Connections, general theory</td>
</tr>
<tr>
<td>53C07</td>
<td>Special connections and metrics on vector bundles (Hermite-Einstein, Yang-Mills) [See also 32Q20]</td>
</tr>
<tr>
<td>53C08</td>
<td>Differential geometric aspects of gerbes and differential characters</td>
</tr>
<tr>
<td>53C10</td>
<td>G-structures</td>
</tr>
<tr>
<td>53C12</td>
<td>Foliations (differential geometric aspects) [See also 57R30, 57R32]</td>
</tr>
<tr>
<td>53C15</td>
<td>General geometric structures on manifolds (almost complex, almost product structures, etc.)</td>
</tr>
<tr>
<td>53C17</td>
<td>Sub-Riemannian geometry</td>
</tr>
<tr>
<td>53C18</td>
<td>Conformal structures on manifolds</td>
</tr>
<tr>
<td>53C20</td>
<td>Global Riemannian geometry, including pinching [See also 31C12, 58B20]</td>
</tr>
<tr>
<td>53C21</td>
<td>Methods of global Riemannian geometry, including PDE methods; curvature restrictions [See also 58J60]</td>
</tr>
<tr>
<td>53C22</td>
<td>Geodesics in global differential geometry [See also 58E10]</td>
</tr>
<tr>
<td>53C23</td>
<td>Global geometric and topological methods (à la Gromov); differential geometric analysis on metric spaces</td>
</tr>
<tr>
<td>53C24</td>
<td>Rigidity results</td>
</tr>
<tr>
<td>53C25</td>
<td>Special Riemannian manifolds (Einstein, Sasakian, etc.)</td>
</tr>
<tr>
<td>53C26</td>
<td>Hyper-Kähler and quaternionic Kähler geometry, “special” geometry</td>
</tr>
<tr>
<td>53C27</td>
<td>Spin and Spin^c geometry</td>
</tr>
<tr>
<td>53C28</td>
<td>Twistor methods in differential geometry [See also 32L25]</td>
</tr>
<tr>
<td>53C29</td>
<td>Issues of holonomy in differential geometry</td>
</tr>
<tr>
<td>Number</td>
<td>Description</td>
</tr>
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<td>---------</td>
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</tr>
<tr>
<td>53C30</td>
<td>Differential geometry of homogeneous manifolds</td>
</tr>
<tr>
<td>53C35</td>
<td>Differential geometry of symmetric spaces</td>
</tr>
<tr>
<td>53C38</td>
<td>Calibrations and calibrated geometries</td>
</tr>
<tr>
<td>53C40</td>
<td>Global submanifolds</td>
</tr>
<tr>
<td>53C42</td>
<td>Differential geometry of immersions (minimal, prescribed curvature, tight, etc.)</td>
</tr>
<tr>
<td>53C43</td>
<td>Differential geometric aspects of harmonic maps</td>
</tr>
<tr>
<td>53C45</td>
<td>Global surface theory (convex surfaces à la A. D. Aleksandrov)</td>
</tr>
<tr>
<td>53C50</td>
<td>Global differential geometry of Lorentz manifolds, manifolds with indefinite metrics</td>
</tr>
<tr>
<td>53C55</td>
<td>Global differential geometry of Hermitian and Kählerian manifolds</td>
</tr>
<tr>
<td>53C56</td>
<td>Other complex differential geometry</td>
</tr>
<tr>
<td>53C60</td>
<td>Global differential geometry of Finsler spaces and generalizations (areal metrics)</td>
</tr>
<tr>
<td>53C65</td>
<td>Integral geometry</td>
</tr>
<tr>
<td>53C70</td>
<td>Direct methods (G-spaces of Busemann, etc.)</td>
</tr>
<tr>
<td>53C75</td>
<td>Geometric orders, order geometry</td>
</tr>
<tr>
<td>53C80</td>
<td>Applications of global differential geometry to the sciences</td>
</tr>
<tr>
<td>53C99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

**53Dxx Symplectic geometry, contact geometry [See also 37Jxx, 70Gxx, 70Hxx]**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>53D05</td>
<td>Symplectic manifolds, general</td>
<td></td>
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<tr>
<td>53D10</td>
<td>Contact manifolds, general</td>
<td></td>
</tr>
<tr>
<td>53D12</td>
<td>Lagrangian submanifolds; Maslov index</td>
<td></td>
</tr>
<tr>
<td>53D15</td>
<td>Almost contact and almost symplectic manifolds</td>
<td></td>
</tr>
<tr>
<td>53D17</td>
<td>Poisson manifolds; Poisson groupoids and algebroids</td>
<td></td>
</tr>
<tr>
<td>53D18</td>
<td>Generalized geometries (à la Hitchin)</td>
<td></td>
</tr>
<tr>
<td>53D20</td>
<td>Momentum maps; symplectic reduction</td>
<td></td>
</tr>
<tr>
<td>53D22</td>
<td>Canonical transformations in symplectic and contact geometry</td>
<td></td>
</tr>
<tr>
<td>53D25</td>
<td>Geodesic flows in symplectic geometry and contact geometry</td>
<td></td>
</tr>
<tr>
<td>53D30</td>
<td>Symplectic structures of moduli spaces</td>
<td></td>
</tr>
<tr>
<td>53D35</td>
<td>Global theory of symplectic and contact manifolds</td>
<td>See also 57Rxx</td>
</tr>
<tr>
<td>53D37</td>
<td>Symplectic aspects of mirror symmetry, homological mirror symmetry, and Fukaya category</td>
<td>See also 14J33</td>
</tr>
<tr>
<td>53D40</td>
<td>Symplectic aspects of Floer homology and cohomology</td>
<td></td>
</tr>
<tr>
<td>53D42</td>
<td>Symplectic field theory; contact homology</td>
<td></td>
</tr>
<tr>
<td>53D45</td>
<td>Gromov-Witten invariants, quantum cohomology, Frobenius manifolds</td>
<td>See also 14N35</td>
</tr>
<tr>
<td>53D50</td>
<td>Geometric quantization</td>
<td></td>
</tr>
<tr>
<td>53D55</td>
<td>Deformation quantization</td>
<td></td>
</tr>
<tr>
<td>53D99</td>
<td>None of the above, but in this section</td>
<td></td>
</tr>
</tbody>
</table>
53Exx Geometric evolution equations
53E10 Flows related to mean curvature
53E20 Ricci flows
53E30 Flows related to complex manifolds (e.g., Kähler-Ricci flows, Chern-Ricci flows)
53E40 Higher-order geometric flows
53E50 Flows related to symplectic and contact structures
53E99 None of the above, but in this section

53Zxx Applications of differential geometry to sciences and engineering
53Z05 Applications of differential geometry to physics
53Z10 Applications of differential geometry to biology
53Z15 Applications of differential geometry to chemistry
53Z30 Applications of differential geometry to data and computer science
53Z99 None of the above, but in this section

54-XX General topology \{For the topology of manifolds of all dimensions, see 57Nxx\}
54-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to general topology
54-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to general topology
54-02 Research exposition (monographs, survey articles) pertaining to general topology
54-03 History of general topology [Consider also classification numbers pertaining to Section 01]
54-04 Software, source code, etc. for problems pertaining to general topology
54-06 Proceedings, conferences, collections, etc. pertaining to general topology
54-08 Computational methods for problems pertaining to general topology
54-11 Research data for problems pertaining to general topology

54Axx Generalities in topology
54A05 Topological spaces and generalizations (closure spaces, etc.)
54A10 Several topologies on one set (change of topology, comparison of topologies, lattices of topologies)
54A15 Syntopogeneous structures
54A20 Convergence in general topology (sequences, filters, limits, convergence spaces, nets, etc.)
54A25 Cardinality properties (cardinal functions and inequalities, discrete subsets) [See also 03Exx] \{For ultrafilters, see 54D80\}
54A35 Consistency and independence results in general topology [See also 03E35]
54A40 Fuzzy topology [See also 03E72]
54A99 None of the above, but in this section
54Bxx Basic constructions in general topology

54B05 Subspaces in general topology

54B10 Product spaces in general topology

54B15 Quotient spaces, decompositions in general topology

54B17 Adjunction spaces and similar constructions in general topology

54B20 Hyperspaces in general topology

54B30 Categorical methods in general topology [See also 18F60]

54B35 Spectra in general topology

54B40 Presheaves and sheaves in general topology [See also 18F20]

54B99 None of the above, but in this section

54Cxx Maps and general types of topological spaces defined by maps

54C05 Continuous maps

54C08 Weak and generalized continuity

54C10 Special maps on topological spaces (open, closed, perfect, etc.)

54C15 Retraction

54C20 Extension of maps

54C25 Embedding

54C30 Real-valued functions in general topology [See also 26-XX]

54C35 Function spaces in general topology [See also 46Exx, 58D15]

54C40 Algebraic properties of function spaces in general topology [See also 46J10]

54C45 $C$- and $C^*$-embedding

54C50 Topology of special sets defined by functions [See also 26A21]

54C55 Absolute neighborhood extensor, absolute extensor, absolute neighborhood retract (ANR), absolute retract spaces (general properties) [See also 55M15]

54C56 Shape theory in general topology [See also 55P55, 57N25]

54C60 Set-valued maps in general topology [See also 26E25, 28B20, 47H04, 58C06]

54C65 Selections in general topology [See also 28B20]

54C70 Entropy in general topology

54C99 None of the above, but in this section

143
54Dxx Fairly general properties of topological spaces

54D05 Connected and locally connected spaces (general aspects)

54D10 Lower separation axioms ($T_0$–$T_3$, etc.)

54D15 Higher separation axioms (completely regular, normal, perfectly or collectionwise normal, etc.)

54D20 Noncompact covering properties (paracompact, Lindelöf, etc.)

54D25 “$P$-minimal” and “$P$-closed” spaces

54D30 Compactness

54D35 Extensions of spaces (compactifications, supercompactifications, completions, etc.)

54D40 Remainders in general topology

54D45 Local compactness, $\sigma$-compactness

54D50 $k$-spaces

54D55 Sequential spaces

54D60 Realcompactness and realcompactification

54D65 Separability of topological spaces

54D70 Base properties of topological spaces

54D80 Special constructions of topological spaces (spaces of ultrafilters, etc.)

54D99 None of the above, but in this section

54Exx Topological spaces with richer structures

54E05 Proximity structures and generalizations

54E15 Uniform structures and generalizations

54E17 Nearness spaces

54E18 $p$-spaces, $M$-spaces, $\sigma$-spaces, etc.

54E20 Stratifiable spaces, cosmic spaces, etc.

54E25 Semimetric spaces

54E30 Moore spaces

54E35 Metric spaces, metrizability

54E40 Special maps on metric spaces

54E45 Compact (locally compact) metric spaces

54E50 Complete metric spaces

54E52 Baire category, Baire spaces

54E55 Bitopologies

54E70 Probabilistic metric spaces

54E99 None of the above, but in this section
54Fxx Special properties of topological spaces
54F05 Linearly ordered topological spaces, generalized ordered spaces, and partially ordered spaces [See also 06B30, 06F30]
54F15 Continua and generalizations
54F16 Hyperspaces of continua
54F17 Inverse limits of set-valued functions
54F35 Higher-dimensional local connectedness [See also 55Mxx, 55Nxx]
54F45 Dimension theory in general topology [See also 55M10]
54F50 Topological spaces of dimension \( \leq 1 \); curves, dendrites [See also 26A03]
54F55 Unicoherence, multicoherence
54F65 Topological characterizations of particular spaces
54F99 None of the above, but in this section

54Gxx Peculiar topological spaces
54G05 Extremally disconnected spaces, \( F \)-spaces, etc.
54G10 \( P \)-spaces
54G12 Scattered spaces
54G15 Pathological topological spaces
54G20 Counterexamples in general topology
54G99 None of the above, but in this section

54Hxx Connections of general topology with other structures, applications
54H05 Descriptive set theory (topological aspects of Borel, analytic, projective, etc. sets) [See also 03E15, 26A21, 28A05]
54H10 Topological representations of algebraic systems [See also 22-XX]
54H11 Topological groups (topological aspects) [See also 22A05]
54H12 Topological lattices, etc. (topological aspects) [See also 06B30, 06F30]
54H13 Topological fields, rings, etc. (topological aspects) [See also 12Jxx] {For algebraic aspects, see 13Jxx, 16W80}
54H15 Transformation groups and semigroups (topological aspects) [See also 20M20, 22-XX, 57Sxx]
54H25 Fixed-point and coincidence theorems (topological aspects) [See also 47H10, 55M20]
54H30 Applications of general topology to computer science (e.g., digital topology, image processing) [See also 68U03]
54H99 None of the above, but in this section

54Jxx Nonstandard topology [See also 03H05]
54J05 Nonstandard topology [See also 03H05]
54J99 None of the above, but in this section
55-XX Algebraic topology

55-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to algebraic topology
55-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to algebraic topology
55-02 Research exposition (monographs, survey articles) pertaining to algebraic topology
55-03 History of algebraic topology [Consider also classification numbers pertaining to Section 01]
55-04 Software, source code, etc. for problems pertaining to algebraic topology
55-06 Proceedings, conferences, collections, etc. pertaining to algebraic topology
55-08 Computational methods for problems pertaining to algebraic topology
55-11 Research data for problems pertaining to algebraic topology

55Mxx Classical topics in algebraic topology {For the topology of Euclidean spaces and manifolds, see 57Nxx}

55M05 Duality in algebraic topology
55M10 Dimension theory in algebraic topology [See also 54F45]
55M15 Absolute neighborhood retracts [See also 54C55]
55M20 Fixed points and coincidences in algebraic topology [See also 54H25]
55M25 Degree, winding number
55M30 Lusternik-Shnirel’man category of a space, topological complexity à la Farber, topological robotics (topological aspects)
55M35 Finite groups of transformations in algebraic topology (including Smith theory) [See also 57S17]
55M99 None of the above, but in this section

55Nxx Homology and cohomology theories in algebraic topology [See also 57Txx]

55N05 Čech types
55N07 Steenrod-Sitnikov homologies
55N10 Singular homology and cohomology theory
55N15 Topological K-theory [See also 19Lxx] {For algebraic K-theory, see 18F25, 19-XX}
55N20 Generalized (extraordinary) homology and cohomology theories in algebraic topology
55N22 Bordism and cobordism theories and formal group laws in algebraic topology [See also 14L05, 19L41, 57R75, 57R77, 57R85, 57R90]
55N25 Homology with local coefficients, equivariant cohomology
55N30 Sheaf cohomology in algebraic topology [See also 18F20, 32C35, 32L10]
55N31 Persistent homology and applications, topological data analysis [See also 62R40, 68T09]
55N32 Orbifold cohomology
55N33 Intersection homology and cohomology in algebraic topology
55N34 Elliptic cohomology
55N35 Other homology theories in algebraic topology
55N40 Axioms for homology theory and uniqueness theorems in algebraic topology
55N45 Products and intersections in homology and cohomology
55N91 Equivariant homology and cohomology in algebraic topology [See also 19L47]
55N99 None of the above, but in this section

55Pxx Homotopy theory {For simple homotopy type, see 57Q10}
55P05 Homotopy extension properties, cofibrations in algebraic topology
55P10 Homotopy equivalences in algebraic topology
55P15 Classification of homotopy type
55P20 Eilenberg-Mac Lane spaces
55P25 Spanier-Whitehead duality
55P30 Eckmann-Hilton duality
55P35 Loop spaces
55P40 Suspensions
55P42 Stable homotopy theory, spectra
55P43 Spectra with additional structure ($E_\infty$, $A_\infty$, ring spectra, etc.)
55P45 $H$-spaces and duals
55P47 Infinite loop spaces
55P48 Loop space machines and operads in algebraic topology [See also 18Mxx]
55P50 String topology
55P55 Shape theory [See also 54C56, 55Q07]
55P57 Proper homotopy theory
55P60 Localization and completion in homotopy theory
55P62 Rational homotopy theory
55P65 Homotopy functors in algebraic topology
55P91 Equivariant homotopy theory in algebraic topology [See also 19L47]
55P92 Relations between equivariant and nonequivariant homotopy theory in algebraic topology
55P99 None of the above, but in this section
55Qxx Homotopy groups
55Q05 Homotopy groups, general; sets of homotopy classes
55Q07 Shape groups
55Q10 Stable homotopy groups
55Q15 Whitehead products and generalizations
55Q20 Homotopy groups of wedges, joins, and simple spaces
55Q25 Hopf invariants
55Q35 Operations in homotopy groups
55Q40 Homotopy groups of spheres
55Q45 Stable homotopy of spheres
55Q50 $J$-morphism [See also 19L20]
55Q51 $v_n$-periodicity
55Q52 Homotopy groups of special spaces
55Q55 Cohomotopy groups
55Q70 Homotopy groups of special types [See also 55N05, 55N07]
55Q91 Equivariant homotopy groups [See also 19L47]
55Q99 None of the above, but in this section

55Rxx Fiber spaces and bundles in algebraic topology [See also 18F15, 32Lxx, 46M20, 57R20, 57R22, 57R25]
55R05 Fiber spaces in algebraic topology
55R10 Fiber bundles in algebraic topology
55R12 Transfer for fiber spaces and bundles in algebraic topology
55R15 Classification of fiber spaces or bundles in algebraic topology
55R20 Spectral sequences and homology of fiber spaces in algebraic topology [See also 55Txx]
55R25 Sphere bundles and vector bundles in algebraic topology
55R35 Classifying spaces of groups and $H$-spaces in algebraic topology
55R37 Maps between classifying spaces in algebraic topology
55R40 Homology of classifying spaces and characteristic classes in algebraic topology [See also 57Txx, 57R20]
55R45 Homology and homotopy of $BO$ and $BU$; Bott periodicity
55R50 Stable classes of vector space bundles in algebraic topology and relations to $K$-theory [See also 19Lxx] {For algebraic $K$-theory, see 18F25, 19-XX}
55R55 Fiberings with singularities in algebraic topology
55R60 Microbundles and block bundles in algebraic topology [See also 57N55, 57Q50]
55R65 Generalizations of fiber spaces and bundles in algebraic topology
55R70 Fibrewise topology
55R80 Discriminantal varieties and configuration spaces in algebraic topology
55R91 Equivariant fiber spaces and bundles in algebraic topology [See also 19L47]
55R99 None of the above, but in this section

55Sxx Operations and obstructions in algebraic topology
55S05 Primary cohomology operations in algebraic topology
55S10 Steenrod algebra
55S12 Dyer-Lashof operations
55S15 Symmetric products and cyclic products in algebraic topology
55S20 Secondary and higher cohomology operations in algebraic topology
55S25 $K$-theory operations and generalized cohomology operations in algebraic topology [See also 19D55, 19Lxx]
55S30 Massey products
55S35 Obstruction theory in algebraic topology
55S36 Extension and compression of mappings in algebraic topology
55S37 Classification of mappings in algebraic topology
55S40 Sectioning fiber spaces and bundles in algebraic topology
55S45 Postnikov systems, $k$-invariants
55S91 Equivariant operations and obstructions in algebraic topology [See also 19L47]
55S99 None of the above, but in this section

55Txx Spectral sequences in algebraic topology [See also 18G40, 55R20]
55T05 General theory of spectral sequences in algebraic topology
55T10 Serre spectral sequences
55T15 Adams spectral sequences
55T20 Eilenberg-Moore spectral sequences [See also 57T35]
55T25 Generalized cohomology and spectral sequences in algebraic topology
55T99 None of the above, but in this section
55Uxx Applied homological algebra and category theory in algebraic topology [See also 18Gxx]

55U05 Abstract complexes in algebraic topology
55U10 Simplicial sets and complexes in algebraic topology
55U15 Chain complexes in algebraic topology
55U20 Universal coefficient theorems, Bockstein operator
55U25 Homology of a product, Künneth formula
55U30 Duality in applied homological algebra and category theory (aspects of algebraic topology)
55U35 Abstract and axiomatic homotopy theory in algebraic topology
55U40 Topological categories, foundations of homotopy theory
55U99 None of the above, but in this section

57-XX Manifolds and cell complexes {For complex manifolds, see 32Qxx}

57-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to manifolds and cell complexes
57-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to manifolds and cell complexes
57-02 Research exposition (monographs, survey articles) pertaining to manifolds and cell complexes
57-03 History of manifolds and cell complexes [Consider also classification numbers pertaining to Section 01]
57-04 Software, source code, etc. for problems pertaining to manifolds and cell complexes
57-06 Proceedings, conferences, collections, etc. pertaining to manifolds and cell complexes
57-08 Computational methods for problems pertaining to manifolds and cell complexes
57-11 Research data for problems pertaining to manifolds and cell complexes

57Kxx Low-dimensional topology in specific dimensions

57K10 Knot theory
57K12 Generalized knots (virtual knots, welded knots, quandles, etc.)
57K14 Knot polynomials
57K16 Finite-type and quantum invariants, topological quantum field theories (TQFT)
57K18 Homology theories in knot theory (Khovanov, Heegaard-Floer, etc.)
57K20 2-dimensional topology (including mapping class groups of surfaces, Teichmüller theory, curve complexes, etc.)
57K30 General topology of 3-manifolds
57K31 Invariants of 3-manifolds (also skein modules; character varieties)
57K32 Hyperbolic 3-manifolds

150
57K33 Contact structures in 3 dimensions [See also 57R17]
57K35 Other geometric structures on 3-manifolds
57K40 General topology of 4-manifolds
57K41 Invariants of 4-manifolds (e.g., Donaldson and Seiberg-Witten invariants)
57K43 Symplectic structures in 4 dimensions [See also 57R17]
57K45 Higher-dimensional knots and links
57K50 Low-dimensional manifolds of specific dimension 5 or higher
57K99 None of the above, but in this section

57Mxx General low-dimensional topology
57M05 Fundamental group, presentations, free differential calculus
57M07 Topological methods in group theory
57M10 Covering spaces and low-dimensional topology
57M12 Low-dimensional topology of special (e.g., branched) coverings
57M15 Relations of low-dimensional topology with graph theory [See also 05Cxx]
57M30 Wild embeddings
57M50 General geometric structures on low-dimensional manifolds
57M60 Group actions on manifolds and cell complexes in low dimensions
57M99 None of the above, but in this section

57Nxx Topological manifolds
57N16 Geometric structures on manifolds of high or arbitrary dimension [See also 57M50]
57N17 Topology of topological vector spaces
57N20 Topology of infinite-dimensional manifolds [See also 58Bxx]
57N25 Shapes (aspects of topological manifolds) [See also 54C56, 55P55, 55Q07]
57N30 Engulfing in topological manifolds
57N35 Embeddings and immersions in topological manifolds
57N37 Isotopy and pseudo-isotopy
57N40 Neighborhoods of submanifolds
57N45 Flatness and tameness of topological manifolds
57N50 $S^{n-1} \subset E^n$, Schoenflies problem
57N55 Microbundles and block bundles [See also 55R60, 57Q50]
57N60 Cellularity in topological manifolds
57N65 Algebraic topology of manifolds
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>57N70</td>
<td>Cobordism and concordance in topological manifolds</td>
</tr>
<tr>
<td>57N75</td>
<td>General position and transversality</td>
</tr>
<tr>
<td>57N80</td>
<td>Stratifications in topological manifolds</td>
</tr>
<tr>
<td>57N99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>57Pxx</td>
<td>Generalized manifolds [See also 18F15]</td>
</tr>
<tr>
<td>57P05</td>
<td>Local properties of generalized manifolds</td>
</tr>
<tr>
<td>57P10</td>
<td>Poincaré duality spaces</td>
</tr>
<tr>
<td>57P99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>57Qxx</td>
<td>PL-topology</td>
</tr>
<tr>
<td>57Q05</td>
<td>General topology of complexes</td>
</tr>
<tr>
<td>57Q10</td>
<td>Simple homotopy type, Whitehead torsion, Reidemeister-Franz torsion, etc.</td>
</tr>
<tr>
<td>57Q12</td>
<td>Wall finiteness obstruction for CW-complexes</td>
</tr>
<tr>
<td>57Q15</td>
<td>Triangulating manifolds</td>
</tr>
<tr>
<td>57Q20</td>
<td>Cobordism in PL-topology</td>
</tr>
<tr>
<td>57Q25</td>
<td>Comparison of PL-structures: classification, Hauptvermutung</td>
</tr>
<tr>
<td>57Q30</td>
<td>Engulfing</td>
</tr>
<tr>
<td>57Q35</td>
<td>Embeddings and immersions in PL-topology</td>
</tr>
<tr>
<td>57Q37</td>
<td>Isotopy in PL-topology</td>
</tr>
<tr>
<td>57Q40</td>
<td>Regular neighborhoods in PL-topology</td>
</tr>
<tr>
<td>57Q50</td>
<td>Microbundles and block bundles [See also 55R60, 57N55]</td>
</tr>
<tr>
<td>57Q55</td>
<td>Approximations in PL-topology</td>
</tr>
<tr>
<td>57Q60</td>
<td>Cobordism and concordance in PL-topology</td>
</tr>
<tr>
<td>57Q65</td>
<td>General position and transversality</td>
</tr>
<tr>
<td>57Q70</td>
<td>Discrete Morse theory and related ideas in manifold topology</td>
</tr>
<tr>
<td>57Q91</td>
<td>Equivariant PL-topology</td>
</tr>
<tr>
<td>57Q99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
57Rxx Differential topology {For foundational questions of differentiable manifolds, see 58Axx; for infinite-dimensional manifolds, see 58Bxx}

57R05 Triangulating
57R10 Smoothing in differential topology
57R12 Smooth approximations in differential topology
57R15 Specialized structures on manifolds (spin manifolds, framed manifolds, etc.)
57R17 Symplectic and contact topology in high or arbitrary dimension [See also 57K33, 57K43]
57R18 Topology and geometry of orbifolds
57R19 Algebraic topology on manifolds and differential topology
57R20 Characteristic classes and numbers in differential topology
57R22 Topology of vector bundles and fiber bundles [See also 55Rxx]
57R25 Vector fields, frame fields in differential topology
57R27 Controllability of vector fields on $C^\infty$ and real-analytic manifolds [See also 49Qxx, 37C10, 93B05]
57R30 Foliations in differential topology; geometric theory [See also 53C12]
57R32 Classifying spaces for foliations; Gelfand-Fuks cohomology [See also 58H10]
57R35 Differentiable mappings in differential topology
57R40 Embeddings in differential topology
57R42 Immersions in differential topology
57R45 Singularities of differentiable mappings in differential topology
57R50 Differential topological aspects of diffeomorphisms
57R52 Isotopy in differential topology
57R55 Differentiable structures in differential topology
57R56 Topological quantum field theories (aspects of differential topology)
57R57 Applications of global analysis to structures on manifolds [See also 57K41, 58-XX]
57R58 Floer homology
57R60 Homotopy spheres, Poincaré conjecture
57R65 Surgery and handlebodies
57R67 Surgery obstructions, Wall groups [See also 19J25]
57R70 Critical points and critical submanifolds in differential topology
57R75 O- and SO-cobordism
57R77 Complex cobordism (U- and SU-cobordism) [See also 55N22]
57R80 h- and s-cobordism
57R85 Equivariant cobordism
57R90 Other types of cobordism [See also 55N22]
57R91 Equivariant algebraic topology of manifolds
57R95 Realizing cycles by submanifolds
57R99 None of the above, but in this section

57Sxx Topological transformation groups [See also 20F34, 22-XX, 37-XX, 54H15, 58D05]
57S05 Topological properties of groups of homeomorphisms or diffeomorphisms
57S10 Compact groups of homeomorphisms
57S12 Toric topology
57S15 Compact Lie groups of differentiable transformations
57S17 Finite transformation groups
57S20 Noncompact Lie groups of transformations
57S25 Groups acting on specific manifolds
57S30 Discontinuous groups of transformations
57S99 None of the above, but in this section

57Txx Homology and homotopy of topological groups and related structures
57T05 Hopf algebras (aspects of homology and homotopy of topological groups) [See also 16T05]
57T10 Homology and cohomology of Lie groups
57T15 Homology and cohomology of homogeneous spaces of Lie groups
57T20 Homotopy groups of topological groups and homogeneous spaces
57T25 Homology and cohomology of \(H\)-spaces
57T30 Bar and cobar constructions [See also 18N40, 55Uxx]
57T35 Applications of Eilenberg-Moore spectral sequences [See also 55R20, 55T20]
57T99 None of the above, but in this section

57Zxx Relations of manifolds and cell complexes with science and engineering
57Z05 Relations of manifolds and cell complexes with physics
57Z10 Relations of manifolds and cell complexes with biology
57Z15 Relations of manifolds and cell complexes with chemistry
57Z20 Relations of manifolds and cell complexes with engineering
57Z25 Relations of manifolds and cell complexes with computer and data science
57Z99 None of the above, but in this section
58-XX Global analysis, analysis on manifolds [See also 32Cxx, 32Fxx, 32Wxx, 46-XX, 47Hxx, 53Cxx] {For geometric integration theory, see 49Q15}

58-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to global analysis
58-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to global analysis
58-02 Research exposition (monographs, survey articles) pertaining to global analysis
58-03 History of global analysis [Consider also classification numbers pertaining to Section 01]
58-04 Software, source code, etc. for problems pertaining to global analysis
58-06 Proceedings, conferences, collections, etc. pertaining to global analysis
58-08 Computational methods for problems pertaining to global analysis
58-11 Research data for problems pertaining to global analysis

58Axx General theory of differentiable manifolds [See also 32Cxx]
58A03 Topos-theoretic approach to differentiable manifolds
58A05 Differentiable manifolds, foundations
58A07 Real-analytic and Nash manifolds [See also 14P20, 32C07]
58A10 Differential forms in global analysis
58A12 de Rham theory in global analysis [See also 14Fxx]
58A14 Hodge theory in global analysis [See also 14C30, 14Fxx, 32J25, 32S35]
58A15 Exterior differential systems (Cartan theory)
58A17 Pfaffian systems
58A20 Jets in global analysis
58A25 Currents in global analysis [See also 32C30, 53C65]
58A30 Vector distributions (subbundles of the tangent bundles)
58A32 Natural bundles
58A35 Stratified sets [See also 32S60]
58A40 Differential spaces
58A50 Supermanifolds and graded manifolds [See also 14A22, 32C11]
58A99 None of the above, but in this section
58Bxx Infinite-dimensional manifolds
58B05 Homotopy and topological questions for infinite-dimensional manifolds
58B10 Differentiability questions for infinite-dimensional manifolds
58B12 Questions of holomorphy and infinite-dimensional manifolds [See also 32-XX, 46G20]
58B15 Fredholm structures on infinite-dimensional manifolds [See also 47A53]
58B20 Riemannian, Finsler and other geometric structures on infinite-dimensional manifolds [See also 53C20, 53C60]
58B25 Group structures and generalizations on infinite-dimensional manifolds [See also 22E65, 58D05]
58B32 Geometry of quantum groups
58B34 Noncommutative geometry (à la Connes)
58B99 None of the above, but in this section

58Cxx Calculus on manifolds; nonlinear operators [See also 46Txx, 47Hxx, 47Jxx]
58C05 Real-valued functions on manifolds
58C06 Set-valued and function-space-valued mappings on manifolds [See also 47H04, 54C60]
58C07 Continuity properties of mappings on manifolds
58C10 Holomorphic maps on manifolds [See also 32-XX]
58C15 Implicit function theorems; global Newton methods on manifolds
58C20 Differentiation theory (Gateaux, Fréchet, etc.) on manifolds [See also 26Exx, 46G05]
58C25 Differentiable maps on manifolds
58C30 Fixed-point theorems on manifolds [See also 47H10]
58C35 Integration on manifolds; measures on manifolds [See also 28Cxx]
58C40 Spectral theory; eigenvalue problems on manifolds [See also 47J10, 58E07]
58C50 Analysis on supermanifolds or graded manifolds
58C99 None of the above, but in this section

58Dxx Spaces and manifolds of mappings (including nonlinear versions of 46Exx) [See also 46Txx, 53Cxx]
58D05 Groups of diffeomorphisms and homeomorphisms as manifolds [See also 22E65, 57S05]
58D07 Groups and semigroups of nonlinear operators [See also 17B65, 47H20]
58D10 Spaces of embeddings and immersions
58D15 Manifolds of mappings [See also 46T10, 54C35]
58D17 Manifolds of metrics (especially Riemannian)
58D19 Group actions and symmetry properties
58D20 Measures (Gaussian, cylindrical, etc.) on manifolds of maps [See also 28Cxx, 46T12]
58D25 Equations in function spaces; evolution equations [See also 34Gxx, 35K90, 35L90, 35R15, 37Lxx, 47Jxx]
58D27 Moduli problems for differential geometric structures
58D29 Moduli problems for topological structures
58D30 Applications of manifolds of mappings to the sciences
58D99 None of the above, but in this section

58Exx Variational problems in infinite-dimensional spaces
58E05 Abstract critical point theory (Morse theory, Lyusternik-Shnirel’man theory, etc.) in infinite-dimensional spaces
58E07 Variational problems in abstract bifurcation theory in infinite-dimensional spaces
58E09 Group-invariant bifurcation theory in infinite-dimensional spaces
58E10 Variational problems in applications to the theory of geodesics (problems in one independent variable)
58E11 Critical metrics
58E12 Variational problems concerning minimal surfaces (problems in two independent variables) [See also 49Q05]
58E15 Variational problems concerning extremal problems in several variables; Yang-Mills functionals [See also 81T13], etc.
58E17 Multiobjective variational problems, Pareto optimality, applications to economics, etc. [See also 90C29, 91Bxx]
58E20 Harmonic maps, etc. [See also 53C43]
58E25 Applications of variational problems to control theory [See also 49-XX, 93-XX]
58E30 Variational principles in infinite-dimensional spaces
58E35 Variational inequalities (global problems) in infinite-dimensional spaces
58E40 Variational aspects of group actions in infinite-dimensional spaces
58E50 Applications of variational problems in infinite-dimensional spaces to the sciences
58E99 None of the above, but in this section

58Hxx Pseudogroups, differentiable groupoids and general structures on manifolds
58H05 Pseudogroups and differentiable groupoids [See also 22A22, 22E65]
58H10 Cohomology of classifying spaces for pseudogroup structures (Spencer, Gelfand-Fuks, etc.) [See also 57R32]
58H15 Deformations of general structures on manifolds [See also 32Gxx, 58J10]
58H99 None of the above, but in this section
58Jxx Partial differential equations on manifolds; differential operators [See also 32Wxx, 35-XX, 53Cxx]

58J05 Elliptic equations on manifolds, general theory [See also 35-XX]

58J10 Differential complexes [See also 35Nxx]; elliptic complexes

58J15 Relations of PDEs on manifolds with hyperfunctions

58J20 Index theory and related fixed-point theorems on manifolds [See also 19K56, 46L80]

58J22 Exotic index theories on manifolds [See also 19K56, 46L05, 46L10, 46L80, 46M20]

58J26 Elliptic genera

58J28 Eta-invariants, Chern-Simons invariants

58J30 Spectral flows

58J32 Boundary value problems on manifolds

58J35 Heat and other parabolic equation methods for PDEs on manifolds

58J37 Perturbations of PDEs on manifolds; asymptotics

58J40 Pseudodifferential and Fourier integral operators on manifolds [See also 35Sxx]

58J42 Noncommutative global analysis, noncommutative residues

58J45 Hyperbolic equations on manifolds [See also 35Lxx]

58J47 Propagation of singularities; initial value problems on manifolds

58J50 Spectral problems; spectral geometry; scattering theory on manifolds [See also 35Pxx]

58J51 Relations between spectral theory and ergodic theory, e.g., quantum unique ergodicity

58J52 Determinants and determinant bundles, analytic torsion

58J53 Isospectrality

58J55 Bifurcation theory for PDEs on manifolds [See also 35B32]

58J60 Relations of PDEs with special manifold structures (Riemannian, Finsler, etc.)

58J65 Diffusion processes and stochastic analysis on manifolds [See also 35R60, 60H10, 60J60]

58J70 Invariance and symmetry properties for PDEs on manifolds [See also 35A30]

58J72 Correspondences and other transformation methods (e.g., Lie-Bäcklund) for PDEs on manifolds [See also 35A22]

58J90 Applications of PDEs on manifolds

58J99 None of the above, but in this section
58Kxx Theory of singularities and catastrophe theory [See also 32Sxx, 37-XX]
58K05 Critical points of functions and mappings on manifolds
58K10 Monodromy on manifolds
58K15 Topological properties of mappings on manifolds
58K20 Algebraic and analytic properties of mappings on manifolds
58K25 Stability theory for manifolds
58K30 Global theory of singularities
58K35 Catastrophe theory
58K40 Classification; finite determinacy of map germs
58K45 Singularities of vector fields, topological aspects
58K50 Normal forms on manifolds
58K55 Asymptotic behavior of solutions to equations on manifolds
58K60 Deformation of singularities
58K65 Topological invariants on manifolds
58K70 Symmetries, equivariance on manifolds
58K99 None of the above, but in this section

58Zxx Applications of global analysis to the sciences
58Z05 Applications of global analysis to the sciences
58Z99 None of the above, but in this section

60-XX Probability theory and stochastic processes {For additional applications, see 05Cxx, 11Kxx, 34-XX, 35-XX, 62-XX, 90-XX, 76-XX, 81-XX, 82-XX, 91-XX, 92-XX, 93-XX, 94-XX}
60-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to probability theory
60-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to probability theory
60-02 Research exposition (monographs, survey articles) pertaining to probability theory
60-03 History of probability theory [Consider also classification numbers pertaining to Section 01]
60-04 Software, source code, etc. for problems pertaining to probability theory
60-06 Proceedings, conferences, collections, etc. pertaining to probability theory
60-08 Computational methods for problems pertaining to probability theory
60-11 Research data for problems pertaining to probability theory
60Axx Foundations of probability theory
60A05 Axioms; other general questions in probability
60A10 Probabilistic measure theory {For ergodic theory, see 28Dxx, 60Fxx}
60A86 Fuzzy probability
60A99 None of the above, but in this section

60Bxx Probability theory on algebraic and topological structures
60B05 Probability measures on topological spaces
60B10 Convergence of probability measures
60B11 Probability theory on linear topological spaces [See also 28C20]
60B12 Limit theorems for vector-valued random variables (infinite-dimensional case)
60B15 Probability measures on groups or semigroups, Fourier transforms, factorization
60B20 Random matrices (probabilistic aspects) {For algebraic aspects, see 15B52}
60B99 None of the above, but in this section

60Cxx Combinatorial probability
60C05 Combinatorial probability
60C99 None of the above, but in this section

60Dxx Geometric probability and stochastic geometry [See also 52A22, 53C65]
60D05 Geometric probability and stochastic geometry [See also 52A22, 53C65]
60D99 None of the above, but in this section

60Exx Distribution theory [See also 62Exx, 62Hxx]
60E05 Probability distributions: general theory
60E07 Infinitely divisible distributions; stable distributions
60E10 Characteristic functions; other transforms
60E15 Inequalities; stochastic orderings
60E99 None of the above, but in this section

60Fxx Limit theorems in probability theory [See also 28Dxx, 60B12]
60F05 Central limit and other weak theorems
60F10 Large deviations
60F15 Strong limit theorems
60F17 Functional limit theorems; invariance principles
60F20 Zero-one laws
60F25 $L^p$-limit theorems
60F99 None of the above, but in this section
60Gxx Stochastic processes

60G05 Foundations of stochastic processes
60G07 General theory of stochastic processes
60G09 Exchangeability for stochastic processes
60G10 Stationary stochastic processes
60G12 General second-order stochastic processes
60G15 Gaussian processes
60G17 Sample path properties
60G18 Self-similar stochastic processes
60G20 Generalized stochastic processes
60G22 Fractional processes, including fractional Brownian motion
60G25 Prediction theory (aspects of stochastic processes) [See also 62M20]
60G30 Continuity and singularity of induced measures
60G35 Signal detection and filtering (aspects of stochastic processes) [See also 62M20, 93E10, 93E11, 94Axx]
60G40 Stopping times; optimal stopping problems; gambling theory [See also 62L15, 91A60]
60G42 Martingales with discrete parameter
60G44 Martingales with continuous parameter
60G46 Martingales and classical analysis
60G48 Generalizations of martingales
60G50 Sums of independent random variables; random walks
60G51 Processes with independent increments; Lévy processes
60G52 Stable stochastic processes
60G53 Feller processes
60G55 Point processes (e.g., Poisson, Cox, Hawkes processes)
60G57 Random measures
60G60 Random fields
60G65 Nonlinear processes (e.g., G-Brownian motion, G-Lévy processes)
60G70 Extreme value theory; extremal stochastic processes
60G99 None of the above, but in this section
**60Hxx Stochastic analysis [See also 58J65]**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60H05</td>
<td>Stochastic integrals</td>
</tr>
<tr>
<td>60H07</td>
<td>Stochastic calculus of variations and the Malliavin calculus</td>
</tr>
<tr>
<td>60H10</td>
<td>Stochastic ordinary differential equations (aspects of stochastic analysis) [See also 34F05]</td>
</tr>
<tr>
<td>60H15</td>
<td>Stochastic partial differential equations (aspects of stochastic analysis) [See also 35R60]</td>
</tr>
<tr>
<td>60H17</td>
<td>Singular stochastic partial differential equations</td>
</tr>
<tr>
<td>60H20</td>
<td>Stochastic integral equations</td>
</tr>
<tr>
<td>60H25</td>
<td>Random operators and equations (aspects of stochastic analysis) [See also 47B80]</td>
</tr>
<tr>
<td>60H30</td>
<td>Applications of stochastic analysis (to PDEs, etc.)</td>
</tr>
<tr>
<td>60H35</td>
<td>Computational methods for stochastic equations (aspects of stochastic analysis) [See also 65C30]</td>
</tr>
<tr>
<td>60H40</td>
<td>White noise theory</td>
</tr>
<tr>
<td>60H50</td>
<td>Regularization by noise</td>
</tr>
<tr>
<td>60H99</td>
<td>None of the above, but in this section</td>
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</table>

**60Jxx Markov processes**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60J05</td>
<td>Discrete-time Markov processes on general state spaces</td>
</tr>
<tr>
<td>60J10</td>
<td>Markov chains (discrete-time Markov processes on discrete state spaces)</td>
</tr>
<tr>
<td>60J20</td>
<td>Applications of Markov chains and discrete-time Markov processes on general state spaces (social mobility, learning theory, industrial processes, etc.) [See also 90B30, 91D10, 91E40]</td>
</tr>
<tr>
<td>60J22</td>
<td>Computational methods in Markov chains [See also 65C40]</td>
</tr>
<tr>
<td>60J25</td>
<td>Continuous-time Markov processes on general state spaces</td>
</tr>
<tr>
<td>60J27</td>
<td>Continuous-time Markov processes on discrete state spaces</td>
</tr>
<tr>
<td>60J28</td>
<td>Applications of continuous-time Markov processes on discrete state spaces</td>
</tr>
<tr>
<td>60J35</td>
<td>Transition functions, generators and resolvents [See also 47D03, 47D07]</td>
</tr>
<tr>
<td>60J40</td>
<td>Right processes</td>
</tr>
<tr>
<td>60J45</td>
<td>Probabilistic potential theory [See also 31Cxx, 31D05]</td>
</tr>
<tr>
<td>60J46</td>
<td>Dirichlet form methods in Markov processes</td>
</tr>
<tr>
<td>60J50</td>
<td>Boundary theory for Markov processes</td>
</tr>
<tr>
<td>60J55</td>
<td>Local time and additive functionals</td>
</tr>
<tr>
<td>60J57</td>
<td>Multiplicative functionals and Markov processes</td>
</tr>
<tr>
<td>60J60</td>
<td>Diffusion processes [See also 58J65]</td>
</tr>
<tr>
<td>60J65</td>
<td>Brownian motion [See also 58J65]</td>
</tr>
<tr>
<td>60J67</td>
<td>Stochastic (Schramm-)Loewner evolution (SLE)</td>
</tr>
<tr>
<td>60J68</td>
<td>Superprocesses</td>
</tr>
<tr>
<td>60J70</td>
<td>Applications of Brownian motions and diffusion theory (population genetics, absorption problems, etc.) [See also 92Dxx]</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>60J75</td>
<td>Jump processes on discrete state spaces</td>
</tr>
<tr>
<td>60J76</td>
<td>Jump processes on general state spaces</td>
</tr>
<tr>
<td>60J80</td>
<td>Branching processes (Galton-Watson, birth-and-death, etc.)</td>
</tr>
<tr>
<td>60J85</td>
<td>Applications of branching processes [See also 92Dxx]</td>
</tr>
<tr>
<td>60J90</td>
<td>Coalescent processes</td>
</tr>
<tr>
<td>60J95</td>
<td>Applications of coalescent processes [See also 92Dxx]</td>
</tr>
<tr>
<td>60J99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

### 60Kxx Special processes

<table>
<thead>
<tr>
<th>60K05</th>
<th>Renewal theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>60K10</td>
<td>Applications of renewal theory (reliability, demand theory, etc.)</td>
</tr>
<tr>
<td>60K15</td>
<td>Markov renewal processes, semi-Markov processes</td>
</tr>
<tr>
<td>60K20</td>
<td>Applications of Markov renewal processes (reliability, queueing networks, etc.) [See also 90Bxx]</td>
</tr>
<tr>
<td>60K25</td>
<td>Queueing theory (aspects of probability theory) [See also 68M20, 90B22]</td>
</tr>
<tr>
<td>60K30</td>
<td>Applications of queueing theory (congestion, allocation, storage, traffic, etc.) [See also 90Bxx]</td>
</tr>
<tr>
<td>60K35</td>
<td>Interacting random processes; statistical mechanics type models; percolation theory [See also 82B43, 82C43]</td>
</tr>
<tr>
<td>60K37</td>
<td>Processes in random environments</td>
</tr>
<tr>
<td>60K40</td>
<td>Other physical applications of random processes</td>
</tr>
<tr>
<td>60K50</td>
<td>Anomalous diffusion models (subdiffusion, superdiffusion, continuous-time random walks, etc.) [See also 60G22, 60G55, 60J75] {For applications to physics and the sciences, see 76-XX, 82Cxx, 92-XX}</td>
</tr>
<tr>
<td>60K99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

### 60Lxx Rough analysis

<table>
<thead>
<tr>
<th>60L10</th>
<th>Signatures and data streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>60L20</td>
<td>Rough paths</td>
</tr>
<tr>
<td>60L30</td>
<td>Regularity structures</td>
</tr>
<tr>
<td>60L40</td>
<td>Paracontrolled distributions and alternative approaches</td>
</tr>
<tr>
<td>60L50</td>
<td>Rough partial differential equations</td>
</tr>
<tr>
<td>60L70</td>
<td>Algebraic structures and computation</td>
</tr>
<tr>
<td>60L90</td>
<td>Applications of rough analysis</td>
</tr>
<tr>
<td>60L99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
62-XX Statistics

62-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to statistics
62-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to statistics
62-02 Research exposition (monographs, survey articles) pertaining to statistics
62-03 History of statistics [Consider also classification numbers pertaining to Section 01]
62-04 Software, source code, etc. for problems pertaining to statistics
62-06 Proceedings, conferences, collections, etc. pertaining to statistics
62-08 Computational methods for problems pertaining to statistics
62-11 Research data for problems pertaining to statistics

62Axx Foundational and philosophical topics in statistics
62A01 Foundations and philosophical topics in statistics
62A09 Graphical methods
62A86 Fuzzy analysis in statistics
62A99 None of the above, but in this section

62Bxx Sufficiency and information
62B05 Sufficient statistics and fields
62B10 Statistical aspects of information-theoretic topics [See also 94A17]
62B11 Information geometry (statistical aspects) {For differential geometric aspects, see 53B12}
62B15 Theory of statistical experiments
62B86 Statistical aspects of fuzziness, sufficiency, and information
62B99 None of the above, but in this section

62Cxx Statistical decision theory [See also 90B50, 91B06] {For game theory, see 91A35}
62C05 General considerations in statistical decision theory
62C07 Complete class results in statistical decision theory
62C10 Bayesian problems; characterization of Bayes procedures
62C12 Empirical decision procedures; empirical Bayes procedures
62C15 Admissibility in statistical decision theory
62C20 Minimax procedures in statistical decision theory
62C25 Compound decision problems in statistical decision theory
62C86 Statistical decision theory and fuzziness
62C99 None of the above, but in this section

164
62Dxx Statistical sampling theory, sample surveys
62D05 Sampling theory, sample surveys
62D10 Missing data
62D20 Causal inference from observational studies
62D99 None of the above, but in this section

62Exx Statistical distribution theory [See also 60Exx]
62E10 Characterization and structure theory of statistical distributions
62E15 Exact distribution theory in statistics
62E17 Approximations to statistical distributions (nonasymptotic)
62E20 Asymptotic distribution theory in statistics
62E86 Fuzziness in connection with statistical distributions
62E99 None of the above, but in this section

62Fxx Parametric inference
62F03 Parametric hypothesis testing
62F05 Asymptotic properties of parametric tests
62F07 Statistical ranking and selection procedures
62F10 Point estimation
62F12 Asymptotic properties of parametric estimators
62F15 Bayesian inference
62F25 Parametric tolerance and confidence regions
62F30 Parametric inference under constraints
62F35 Robustness and adaptive procedures (parametric inference)
62F40 Bootstrap, jackknife and other resampling methods
62F86 Parametric inference and fuzziness
62F99 None of the above, but in this section

62Gxx Nonparametric inference
62G05 Nonparametric estimation
62G07 Density estimation
62G08 Nonparametric regression and quantile regression
62G09 Nonparametric statistical resampling methods
62G10 Nonparametric hypothesis testing
62G15 Nonparametric tolerance and confidence regions
62G20 Asymptotic properties of nonparametric inference
62G30 Order statistics; empirical distribution functions
62G32 Statistics of extreme values; tail inference
62G35 Nonparametric robustness
62G86 Nonparametric inference and fuzziness
62G99 None of the above, but in this section

62Hxx Multivariate analysis [See also 60Exx]
62H05 Characterization and structure theory for multivariate probability distributions; copulas
62H10 Multivariate distribution of statistics
62H11 Directional data; spatial statistics
62H12 Estimation in multivariate analysis
62H15 Hypothesis testing in multivariate analysis
62H17 Contingency tables
62H20 Measures of association (correlation, canonical correlation, etc.)
62H22 Probabilistic graphical models
62H25 Factor analysis and principal components; correspondence analysis
62H30 Classification and discrimination; cluster analysis (statistical aspects) [See also 68T10, 91C20]; mixture models
62H35 Image analysis in multivariate analysis
62H86 Multivariate analysis and fuzziness
62H99 None of the above, but in this section

62Jxx Linear inference, regression
62J02 General nonlinear regression
62J05 Linear regression; mixed models
62J07 Ridge regression; shrinkage estimators (Lasso)
62J10 Analysis of variance and covariance (ANOVA)
62J12 Generalized linear models (logistic models)
62J15 Paired and multiple comparisons; multiple testing
62J20 Diagnostics, and linear inference and regression
62J86 Fuzziness, and linear inference and regression
62J99 None of the above, but in this section
62Kxx Design of statistical experiments [See also 05Bxx]
62K05 Optimal statistical designs
62K10 Statistical block designs
62K15 Factorial statistical designs
62K20 Response surface designs
62K25 Robust parameter designs
62K86 Fuzziness and design of statistical experiments
62K99 None of the above, but in this section

62Lxx Sequential statistical methods
62L05 Sequential statistical design
62L10 Sequential statistical analysis
62L12 Sequential estimation
62L15 Optimal stopping in statistics [See also 60G40, 91A60]
62L20 Stochastic approximation
62L86 Fuzziness and sequential statistical methods
62L99 None of the above, but in this section

62Mxx Inference from stochastic processes
62M02 Markov processes: hypothesis testing
62M05 Markov processes: estimation; hidden Markov models
62M07 Non-Markovian processes: hypothesis testing
62M09 Non-Markovian processes: estimation
62M10 Time series, auto-correlation, regression, etc. in statistics (GARCH) [See also 91B84]
62M15 Inference from stochastic processes and spectral analysis
62M20 Inference from stochastic processes and prediction [See also 60G25]; filtering [See also 60G35, 93E10, 93E11]
62M30 Inference from spatial processes
62M40 Random fields; image analysis
62M45 Neural nets and related approaches to inference from stochastic processes
62M86 Inference from stochastic processes and fuzziness
62M99 None of the above, but in this section
62Nxx Survival analysis and censored data
62N01 Censored data models
62N02 Estimation in survival analysis and censored data
62N03 Testing in survival analysis and censored data
62N05 Reliability and life testing [See also 90B25]
62N86 Fuzziness, and survival analysis and censored data
62N99 None of the above, but in this section

62Pxx Applications of statistics [See also 90-XX, 91-XX, 92-XX]
62P05 Applications of statistics to actuarial sciences and financial mathematics
62P10 Applications of statistics to biology and medical sciences; meta analysis
62P12 Applications of statistics to environmental and related topics
62P15 Applications of statistics to psychology
62P20 Applications of statistics to economics [See also 91Bxx]
62P25 Applications of statistics to social sciences
62P30 Applications of statistics in engineering and industry; control charts
62P35 Applications of statistics to physics
62P99 None of the above, but in this section

62Qxx Statistical tables
62Q05 Statistical tables
62Q99 None of the above, but in this section

62Rxx Statistics on algebraic and topological structures
62R01 Algebraic statistics
62R07 Statistical aspects of big data and data science {For computer science aspects, see 68T09; for information-theoretic aspects, see 94A16}
62R10 Functional data analysis
62R20 Statistics on metric spaces
62R30 Statistics on manifolds
62R40 Topological data analysis [See also 55N31]
62R99 None of the above, but in this section
65-XX Numerical analysis

65-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to numerical analysis
65-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to numerical analysis
65-02 Research exposition (monographs, survey articles) pertaining to numerical analysis
65-03 History of numerical analysis [Consider also classification numbers pertaining to Section 01]
65-04 Software, source code, etc. for problems pertaining to numerical analysis
65-06 Proceedings, conferences, collections, etc. pertaining to numerical analysis
65-11 Research data for problems pertaining to numerical analysis

65Axx Tables in numerical analysis

65A05 Tables in numerical analysis
65A99 None of the above, but in this section

65Bxx Acceleration of convergence in numerical analysis

65B05 Extrapolation to the limit, deferred corrections
65B10 Numerical summation of series
65B15 Euler-Maclaurin formula in numerical analysis
65B99 None of the above, but in this section

65Cxx Probabilistic methods, stochastic differential equations

65C05 Monte Carlo methods [See also 82M31]
65C10 Random number generation in numerical analysis [See also 11K45]
65C20 Probabilistic models, generic numerical methods in probability and statistics [See also 60-08, 62-08]
65C30 Numerical solutions to stochastic differential and integral equations {For theoretical aspects, see 60H35} [See also 65M75, 65N75]
65C35 Stochastic particle methods [See also 82M60]
65C40 Numerical analysis or methods applied to Markov chains [See also 60J22]
65C99 None of the above, but in this section

65Dxx Numerical approximation and computational geometry (primarily algorithms) {For theoretical aspects, see 41-XX, 68Uxx}

65D05 Numerical interpolation
65D07 Numerical computation using splines
65D10 Numerical smoothing, curve fitting
65D12 Numerical radial basis function approximation
65D15 Algorithms for approximation of functions
65D17 Computer-aided design (modeling of curves and surfaces) [See also 68U07]
65D18 Numerical aspects of computer graphics, image analysis, and computational geometry [See also 51N05, 68U05]
65D19 Computational issues in computer and robotic vision
65D20 Computation of special functions and constants, construction of tables [See also 33F05]
65D25 Numerical differentiation
65D30 Numerical integration
65D32 Numerical quadrature and cubature formulas
65D40 High-dimensional functions; sparse grids
65D99 None of the above, but in this section

65Exx Numerical methods in complex analysis (potential theory, etc.)
65E05 Numerical methods in complex analysis (potential theory, etc.) [See also 30-08, 31-08, 32-08]
65E10 Numerical methods in conformal mappings [See also 30C30]
65E99 None of the above, but in this section

65Fxx Numerical linear algebra
65F05 Direct numerical methods for linear systems and matrix inversion
65F08 Preconditioners for iterative methods
65F10 Iterative numerical methods for linear systems [See also 65N22]
65F15 Numerical computation of eigenvalues and eigenvectors of matrices
65F18 Numerical solutions to inverse eigenvalue problems
65F20 Numerical solutions to overdetermined systems, pseudoinverses
65F22 Ill-posedness and regularization problems in numerical linear algebra
65F25 Orthogonalization in numerical linear algebra
65F30 Other numerical matrix algorithms
65F35 Numerical computation of matrix norms, conditioning, scaling [See also 15A12, 15A60]
65F40 Numerical computation of determinants
65F45 Numerical methods for matrix equations
65F50 Computational methods for sparse matrices
65F55 Numerical methods for low-rank matrix approximation; matrix compression
65F60 Numerical computation of matrix exponential and similar matrix functions
65F99 None of the above, but in this section
65Gxx Error analysis and interval analysis
65G20 Algorithms with automatic result verification
65G30 Interval and finite arithmetic
65G40 General methods in interval analysis
65G50 Roundoff error
65G99 None of the above, but in this section

65Hxx Nonlinear algebraic or transcendental equations
65H04 Numerical computation of roots of polynomial equations
65H05 Numerical computation of solutions to single equations
65H10 Numerical computation of solutions to systems of equations
65H14 Numerical algebraic geometry
65H17 Numerical solution of nonlinear eigenvalue and eigenvector problems [See also 47Hxx, 47Jxx, 58C40, 58E07, 90C30]
65H20 Global methods, including homotopy approaches to the numerical solution of nonlinear equations [See also 58C30, 90C30]
65H99 None of the above, but in this section

65Jxx Numerical analysis in abstract spaces
65J05 General theory of numerical analysis in abstract spaces
65J08 Numerical solutions to abstract evolution equations
65J10 Numerical solutions to equations with linear operators (do not use 65Fxx)
65J15 Numerical solutions to equations with nonlinear operators (do not use 65Hxx)
65J20 Numerical solutions of ill-posed problems in abstract spaces; regularization
65J22 Numerical solution to inverse problems in abstract spaces
65J99 None of the above, but in this section

65Kxx Numerical methods for mathematical programming, optimization and variational techniques
65K05 Numerical mathematical programming methods [See also 90Cxx]
65K10 Numerical optimization and variational techniques [See also 49Mxx, 93-08]
65K15 Numerical methods for variational inequalities and related problems
65K99 None of the above, but in this section
### 65Lxx Numerical methods for ordinary differential equations

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>65L03</td>
<td>Numerical methods for functional-differential equations</td>
</tr>
<tr>
<td>65L04</td>
<td>Numerical methods for stiff equations</td>
</tr>
<tr>
<td>65L05</td>
<td>Numerical methods for initial value problems</td>
</tr>
<tr>
<td>65L06</td>
<td>Multistep, Runge-Kutta and extrapolation methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L07</td>
<td>Numerical investigation of stability of solutions</td>
</tr>
<tr>
<td>65L08</td>
<td>Numerical solution of ill-posed problems involving ordinary differential equations</td>
</tr>
<tr>
<td>65L09</td>
<td>Numerical solution of inverse problems involving ordinary differential equations</td>
</tr>
<tr>
<td>65L10</td>
<td>Numerical solution of boundary value problems involving ordinary differential equations</td>
</tr>
<tr>
<td>65L11</td>
<td>Numerical solution of singularly perturbed problems involving ordinary differential equations</td>
</tr>
<tr>
<td>65L12</td>
<td>Finite difference and finite volume methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L15</td>
<td>Numerical solution of eigenvalue problems involving ordinary differential equations</td>
</tr>
<tr>
<td>65L20</td>
<td>Stability and convergence of numerical methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L50</td>
<td>Mesh generation, refinement, and adaptive methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L60</td>
<td>Finite element, Rayleigh-Ritz, Galerkin and collocation methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L70</td>
<td>Error bounds for numerical methods for ordinary differential equations</td>
</tr>
<tr>
<td>65L80</td>
<td>Numerical methods for differential-algebraic equations</td>
</tr>
<tr>
<td>65L99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

### 65Mxx Numerical methods for partial differential equations, initial value and time-dependent initial-boundary value problems

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>65M06</td>
<td>Finite difference methods for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M08</td>
<td>Finite volume methods for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M12</td>
<td>Stability and convergence of numerical methods for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M15</td>
<td>Error bounds for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M20</td>
<td>Method of lines for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M22</td>
<td>Numerical solution of discretized equations for initial value and initial-boundary value problems involving PDEs [See also 65Fxx, 65Hxx]</td>
</tr>
<tr>
<td>65M25</td>
<td>Numerical aspects of the method of characteristics for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M30</td>
<td>Numerical methods for ill-posed problems for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M32</td>
<td>Numerical methods for inverse problems for initial value and initial-boundary value problems involving PDEs</td>
</tr>
<tr>
<td>65M38</td>
<td>Boundary element methods for initial value and initial-boundary value problems involving PDEs</td>
</tr>
</tbody>
</table>
65M50 Mesh generation, refinement, and adaptive methods for the numerical solution of initial value and initial-boundary value problems involving PDEs

65M55 Multigrid methods; domain decomposition for initial value and initial-boundary value problems involving PDEs

65M60 Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs

65M70 Spectral, collocation and related methods for initial value and initial-boundary value problems involving PDEs

65M75 Probabilistic methods, particle methods, etc. for initial value and initial-boundary value problems involving PDEs

65M80 Fundamental solutions, Green’s function methods, etc. for initial value and initial-boundary value problems involving PDEs

65M85 Fictitious domain methods for initial value and initial-boundary value problems involving PDEs

65M99 None of the above, but in this section

65Nxx Numerical methods for partial differential equations, boundary value problems

65N06 Finite difference methods for boundary value problems involving PDEs

65N08 Finite volume methods for boundary value problems involving PDEs

65N12 Stability and convergence of numerical methods for boundary value problems involving PDEs

65N15 Error bounds for boundary value problems involving PDEs

65N20 Numerical methods for ill-posed problems for boundary value problems involving PDEs

65N21 Numerical methods for inverse problems for boundary value problems involving PDEs

65N22 Numerical solution of discretized equations for boundary value problems involving PDEs [See also 65Fxx, 65Hxx]

65N25 Numerical methods for eigenvalue problems for boundary value problems involving PDEs

65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs

65N35 Spectral, collocation and related methods for boundary value problems involving PDEs

65N38 Boundary element methods for boundary value problems involving PDEs

65N40 Method of lines for boundary value problems involving PDEs

65N45 Method of contraction of the boundary for boundary value problems involving PDEs

65N50 Mesh generation, refinement, and adaptive methods for boundary value problems involving PDEs

65N55 Multigrid methods; domain decomposition for boundary value problems involving PDEs

65N75 Probabilistic methods, particle methods, etc. for boundary value problems involving PDEs

65N80 Fundamental solutions, Green’s function methods, etc. for boundary value problems involving PDEs

65N85 Fictitious domain methods for boundary value problems involving PDEs

65N99 None of the above, but in this section
65Pxx Numerical problems in dynamical systems [See also 37Mxx]
  65P10 Numerical methods for Hamiltonian systems including symplectic integrators
  65P20 Numerical chaos
  65P30 Numerical bifurcation problems
  65P40 Numerical nonlinear stabilities in dynamical systems
  65P99 None of the above, but in this section

65Qxx Numerical methods for difference and functional equations, recurrence relations
  65Q10 Numerical methods for difference equations
  65Q20 Numerical methods for functional equations
  65Q30 Numerical aspects of recurrence relations
  65Q99 None of the above, but in this section

65Rxx Numerical methods for integral equations, integral transforms
  65R10 Numerical methods for integral transforms
  65R15 Numerical methods for eigenvalue problems in integral equations
  65R20 Numerical methods for integral equations
  65R30 Numerical methods for ill-posed problems for integral equations
  65R32 Numerical methods for inverse problems for integral equations
  65R99 None of the above, but in this section

65Sxx Graphical methods in numerical analysis
  65S05 Graphical methods in numerical analysis
  65S99 None of the above, but in this section

65Txx Numerical methods in Fourier analysis
  65T40 Numerical methods for trigonometric approximation and interpolation
  65T50 Numerical methods for discrete and fast Fourier transforms
  65T60 Numerical methods for wavelets
  65T99 None of the above, but in this section

65Yxx Computer aspects of numerical algorithms
  65Y04 Numerical algorithms for computer arithmetic, etc. [See also 68M07]
  65Y05 Parallel numerical computation
  65Y10 Numerical algorithms for specific classes of architectures
  65Y15 Packaged methods for numerical algorithms
  65Y20 Complexity and performance of numerical algorithms [See also 68Q25]
  65Y99 None of the above, but in this section
65Zxx Applications to the sciences
65Z05 Applications to the sciences
65Z99 None of the above, but in this section

68-XX Computer science {For papers containing software, source code, etc. in a specific mathematical area, see the classification number -04 in that area}

68-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to computer science
68-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to computer science
68-02 Research exposition (monographs, survey articles) pertaining to computer science
68-03 History of computer science [Consider also classification numbers pertaining to Section 01]
68-04 Software, source code, etc. for problems pertaining to computer science
68-06 Proceedings, conferences, collections, etc. pertaining to computer science
68-11 Research data for problems pertaining to computer science

68Mxx Computer system organization
68M01 General theory of computer systems
68M07 Mathematical problems of computer architecture [See also 68W35]
68M10 Network design and communication in computer systems [See also 68R10, 90B18]
68M11 Internet topics [See also 68U35]
68M12 Network protocols
68M14 Distributed systems
68M15 Reliability, testing and fault tolerance of networks and computer systems
68M18 Wireless sensor networks as related to computer science [See also 90B18, 90B80]
68M20 Performance evaluation, queueing, and scheduling in the context of computer systems [See also 60K20, 60K25, 90B22, 90B35, 90B36]
68M25 Computer security
68M99 None of the above, but in this section

68Nxx Theory of software
68N01 General topics in the theory of software
68N15 Theory of programming languages
68N17 Logic programming
68N18 Functional programming and lambda calculus [See also 03B40]
68N19 Other programming paradigms (object-oriented, sequential, concurrent, automatic, etc.)
68N20 Theory of compilers and interpreters
68N25 Theory of operating systems
68N30 Mathematical aspects of software engineering (specification, verification, metrics, requirements, etc.)
68N99 None of the above, but in this section

68Pxx Theory of data
68P01 General topics in the theory of data
68P05 Data structures
68P10 Searching and sorting
68P15 Database theory
68P20 Information storage and retrieval of data
68P25 Data encryption (aspects in computer science) [See also 81P94, 94A60]
68P27 Privacy of data
68P30 Coding and information theory (compaction, compression, models of communication, encoding schemes, etc.)
(aspects in computer science) [See also 94Axx, 94Bxx]
68P99 None of the above, but in this section

68Qxx Theory of computing
68Q01 General topics in the theory of computing
68Q04 Classical models of computation (Turing machines, etc.) [See also 03D10]
68Q06 Networks and circuits as models of computation; circuit complexity [See also 94C11]
68Q07 Biologically inspired models of computation (DNA computing, membrane computing, etc.)
68Q09 Other nonclassical models of computation {For quantum computing, see mainly 68Q12, 81P68}
68Q10 Modes of computation (nondeterministic, parallel, interactive, probabilistic, etc.) [See also 68Q85]
68Q11 Communication complexity, information complexity
68Q12 Quantum algorithms and complexity in the theory of computing [See also 68Q09, 81P68]
68Q15 Complexity classes (hierarchies, relations among complexity classes, etc.) [See also 03D15, 68Q17, 68Q19]
68Q17 Computational difficulty of problems (lower bounds, completeness, difficulty of approximation, etc.) [See also 68Q15]
68Q19 Descriptive complexity and finite models [See also 03C13]
68Q25 Analysis of algorithms and problem complexity [See also 68W40]
68Q27 Parameterized complexity, tractability and kernelization
68Q30 Algorithmic information theory (Kolmogorov complexity, etc.) [See also 03D32]
68Q32 Computational learning theory [See also 68T05]
68Q42 Grammars and rewriting systems
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>68Q45</td>
<td>Formal languages and automata [See also 03D05, 68Q70, 94A45]</td>
</tr>
<tr>
<td>68Q55</td>
<td>Semantics in the theory of computing [See also 03B70, 06B35, 18C50]</td>
</tr>
<tr>
<td>68Q60</td>
<td>Specification and verification (program logics, model checking, etc.) [See also 03B70]</td>
</tr>
<tr>
<td>68Q65</td>
<td>Abstract data types; algebraic specification [See also 18C50]</td>
</tr>
<tr>
<td>68Q70</td>
<td>Algebraic theory of languages and automata [See also 18B20, 20M35]</td>
</tr>
<tr>
<td>68Q80</td>
<td>Cellular automata (computational aspects) {For cellular automata as dynamical systems, see 37B15}</td>
</tr>
<tr>
<td>68Q85</td>
<td>Models and methods for concurrent and distributed computing (process algebras, bisimulation, transition nets, etc.) [See also 68W20, 68W40]</td>
</tr>
<tr>
<td>68Q87</td>
<td>Probability in computer science (algorithm analysis, random structures, phase transitions, etc.) [See also 68W20, 68W40]</td>
</tr>
<tr>
<td>68Q99</td>
<td>None of the above, but in this section</td>
</tr>
<tr>
<td>68Rxx</td>
<td>Discrete mathematics in relation to computer science</td>
</tr>
<tr>
<td>68R01</td>
<td>General topics of discrete mathematics in relation to computer science</td>
</tr>
<tr>
<td>68R05</td>
<td>Combinatorics in computer science</td>
</tr>
<tr>
<td>68R07</td>
<td>Computational aspects of satisfiability [See also 68T20]</td>
</tr>
<tr>
<td>68R10</td>
<td>Graph theory (including graph drawing) in computer science [See also 05Cxx, 90B10, 90C35]</td>
</tr>
<tr>
<td>68R12</td>
<td>Metric embeddings as related to computational problems and algorithms</td>
</tr>
<tr>
<td>68R15</td>
<td>Combinatorics on words</td>
</tr>
<tr>
<td>68R99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

**68Txx Artificial intelligence**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>68T01</td>
<td>General topics in artificial intelligence</td>
</tr>
<tr>
<td>68T05</td>
<td>Learning and adaptive systems in artificial intelligence [See also 68Q32]</td>
</tr>
<tr>
<td>68T07</td>
<td>Artificial neural networks and deep learning</td>
</tr>
<tr>
<td>68T09</td>
<td>Computational aspects of data analysis and big data [See also 62R07] {For homological aspects, see 55N31}</td>
</tr>
<tr>
<td>68T10</td>
<td>Pattern recognition, speech recognition {For cluster analysis, see 62H30}</td>
</tr>
<tr>
<td>68T20</td>
<td>Problem solving in the context of artificial intelligence (heuristics, search strategies, etc.)</td>
</tr>
<tr>
<td>68T27</td>
<td>Logic in artificial intelligence</td>
</tr>
<tr>
<td>68T30</td>
<td>Knowledge representation</td>
</tr>
<tr>
<td>68T35</td>
<td>Theory of languages and software systems (knowledge-based systems, expert systems, etc.) for artificial intelligence</td>
</tr>
<tr>
<td>68T37</td>
<td>Reasoning under uncertainty in the context of artificial intelligence</td>
</tr>
<tr>
<td>68T40</td>
<td>Artificial intelligence for robotics [See also 93C85]</td>
</tr>
<tr>
<td>68T42</td>
<td>Agent technology and artificial intelligence</td>
</tr>
<tr>
<td>68T45</td>
<td>Machine vision and scene understanding</td>
</tr>
<tr>
<td>68T50</td>
<td>Natural language processing [See also 03B65, 91F20]</td>
</tr>
<tr>
<td>68T99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
68Uxx Computing methodologies and applications

68U01 General topics in computing methodologies

68U03 Computational aspects of digital topology {For topological aspects, see 54H30; for homological aspects, see 55-XX}

68U05 Computer graphics; computational geometry (digital and algorithmic aspects) {For methods of numerical mathematics, see 65D18}

68U07 Computer science aspects of computer-aided design {For methods of numerical mathematics, see 65D17}

68U10 Computing methodologies for image processing

68U15 Computing methodologies for text processing; mathematical typography

68U35 Computing methodologies for information systems (hypertext navigation, interfaces, decision support, etc.) [See also 68M11]

68U99 None of the above, but in this section

68Vxx Computer science support for mathematical research and practice

68V05 Computer assisted proofs of proofs-by-exhaustion type {For rigorous numerics, see 65Gxx; for proofs employing automated or interactive theorem provers, see 68V15}

68V15 Theorem proving (automated and interactive theorem provers, deduction, resolution, etc.) [See also 03B35]

68V20 Formalization of mathematics in connection with theorem provers [See also 03B35, 68V15]

68V25 Presentation and content markup for mathematics

68V30 Mathematical knowledge management

68V35 Digital mathematics libraries and repositories

68V99 None of the above, but in this section

68Wxx Algorithms in computer science {For numerical algorithms, see 65-XX; for combinatorics and graph theory, see 05C85, 68Rxx}

68W01 General topics in the theory of algorithms

68W05 Nonnumerical algorithms

68W10 Parallel algorithms in computer science

68W15 Distributed algorithms

68W20 Randomized algorithms

68W25 Approximation algorithms

68W27 Online algorithms; streaming algorithms

68W30 Symbolic computation and algebraic computation [See also 11Yxx, 12-08, 13Pxx, 14Qxx, 16Z05, 17-08, 33F10]

68W32 Algorithms on strings

68W35 Hardware implementations of nonnumerical algorithms (VLSI algorithms, etc.) [See also 68M07]

68W40 Analysis of algorithms [See also 68Q25]

68W50 Evolutionary algorithms, genetic algorithms (computational aspects) [See also 68T05, 68T20, 90C59]

68W99 None of the above, but in this section
70-XX Mechanics of particles and systems {For relativistic mechanics, see 83A05, 83C10; for statistical mechanics, see 82-XX}

70-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to mechanics of particles and systems

70-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mechanics of particles and systems

70-02 Research exposition (monographs, survey articles) pertaining to mechanics of particles and systems

70-03 History of mechanics of particles and systems [Consider also classification numbers pertaining to Section 01]

70-04 Software, source code, etc. for problems pertaining to mechanics of particles and systems

70-05 Experimental work for problems pertaining to mechanics of particles and systems

70-06 Proceedings, conferences, collections, etc. pertaining to mechanics of particles and systems

70-08 Computational methods for problems pertaining to mechanics of particles and systems

70-10 Mathematical modeling or simulation for problems pertaining to mechanics of particles and systems

70-11 Research data for problems pertaining to mechanics of particles and systems

70Axx Axiomatics, foundations

70A05 Axiomatics, foundations

70A99 None of the above, but in this section

70Bxx Kinematics [See also 53A17]

70B05 Kinematics of a particle

70B10 Kinematics of a rigid body

70B15 Kinematics of mechanisms and robots [See also 68T40, 70Q05, 93C85]

70B99 None of the above, but in this section

70Cxx Statics

70C20 Statics

70C99 None of the above, but in this section

70Exx Dynamics of a rigid body and of multibody systems

70E05 Motion of the gyroscope

70E15 Free motion of a rigid body [See also 70M20]

70E17 Motion of a rigid body with a fixed point

70E18 Motion of a rigid body in contact with a solid surface [See also 70F25]

70E20 Perturbation methods for rigid body dynamics

70E40 Integrable cases of motion in rigid body dynamics

70E45 Higher-dimensional generalizations in rigid body dynamics
70E50 Stability problems in rigid body dynamics
70E55 Dynamics of multibody systems
70E60 Robot dynamics and control of rigid bodies [See also 68T40, 70Q05, 93C85]
70E99 None of the above, but in this section

70Fxx Dynamics of a system of particles, including celestial mechanics
70F05 Two-body problems
70F07 Three-body problems
70F10 n-body problems
70F15 Celestial mechanics
70F16 Collisions in celestial mechanics, regularization
70F17 Inverse problems for systems of particles
70F20 Holonomic systems related to the dynamics of a system of particles
70F25 Nonholonomic systems related to the dynamics of a system of particles
70F35 Collision of rigid or pseudo-rigid bodies
70F40 Problems involving a system of particles with friction
70F45 The dynamics of infinite particle systems
70F99 None of the above, but in this section

70Gxx General models, approaches, and methods [See also 37-XX]
70G10 Generalized coordinates; event, impulse-energy, configuration, state, or phase space for problems in mechanics
70G40 Topological and differential topological methods for problems in mechanics
70G45 Differential geometric methods (tensors, connections, symplectic, Poisson, contact, Riemannian, nonholonomic, etc.) for problems in mechanics [See also 53Cxx, 53Dxx, 58Axx]
70G55 Algebraic geometry methods for problems in mechanics
70G60 Dynamical systems methods for problems in mechanics
70G65 Symmetries, Lie group and Lie algebra methods for problems in mechanics
70G70 Functional analytic methods for problems in mechanics
70G75 Variational methods for problems in mechanics
70G99 None of the above, but in this section
70Hxx Hamiltonian and Lagrangian mechanics [See also 37Jxx]

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>70H03</td>
<td>Lagrange’s equations</td>
</tr>
<tr>
<td>70H05</td>
<td>Hamilton’s equations</td>
</tr>
<tr>
<td>70H06</td>
<td>Completely integrable systems and methods of integration for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H07</td>
<td>Nonintegrable systems for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H08</td>
<td>Nearly integrable Hamiltonian systems, KAM theory</td>
</tr>
<tr>
<td>70H09</td>
<td>Perturbation theories for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H11</td>
<td>Adiabatic invariants for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H12</td>
<td>Periodic and almost periodic solutions for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H14</td>
<td>Stability problems for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H15</td>
<td>Canonical and symplectic transformations for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H20</td>
<td>Hamilton-Jacobi equations in mechanics</td>
</tr>
<tr>
<td>70H25</td>
<td>Hamilton’s principle</td>
</tr>
<tr>
<td>70H30</td>
<td>Other variational principles in mechanics</td>
</tr>
<tr>
<td>70H33</td>
<td>Symmetries and conservation laws, reverse symmetries, invariant manifolds and their bifurcations, reduction for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H40</td>
<td>Relativistic dynamics for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H45</td>
<td>Constrained dynamics, Dirac’s theory of constraints [See also 70F20, 70F25, 70Gxx]</td>
</tr>
<tr>
<td>70H50</td>
<td>Higher-order theories for problems in Hamiltonian and Lagrangian mechanics</td>
</tr>
<tr>
<td>70H99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

70Jxx Linear vibration theory

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>70J10</td>
<td>Modal analysis in linear vibration theory</td>
</tr>
<tr>
<td>70J25</td>
<td>Stability for problems in linear vibration theory</td>
</tr>
<tr>
<td>70J30</td>
<td>Free motions in linear vibration theory</td>
</tr>
<tr>
<td>70J35</td>
<td>Forced motions in linear vibration theory</td>
</tr>
<tr>
<td>70J40</td>
<td>Parametric resonances in linear vibration theory</td>
</tr>
<tr>
<td>70J50</td>
<td>Systems arising from the discretization of structural vibration problems</td>
</tr>
<tr>
<td>70J99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
70Kxx Nonlinear dynamics in mechanics [See also 34Cxx, 37-XX]

70K05 Phase plane analysis, limit cycles for nonlinear problems in mechanics

70K20 Stability for nonlinear problems in mechanics

70K25 Free motions for nonlinear problems in mechanics

70K28 Parametric resonances for nonlinear problems in mechanics

70K30 Nonlinear resonances for nonlinear problems in mechanics

70K40 Forced motions for nonlinear problems in mechanics

70K42 Equilibria and periodic trajectories for nonlinear problems in mechanics

70K43 Quasi-periodic motions and invariant tori for nonlinear problems in mechanics

70K44 Homoclinic and heteroclinic trajectories for nonlinear problems in mechanics

70K45 Normal forms for nonlinear problems in mechanics

70K50 Bifurcations and instability for nonlinear problems in mechanics

70K55 Transition to stochasticity (chaotic behavior) for nonlinear problems in mechanics [See also 37D45]

70K60 General perturbation schemes for nonlinear problems in mechanics

70K65 Averaging of perturbations for nonlinear problems in mechanics

70K70 Systems with slow and fast motions for nonlinear problems in mechanics

70K75 Nonlinear modes

70K99 None of the above, but in this section

70Lxx Random and stochastic aspects of the mechanics of particles and systems

70L05 Random vibrations in mechanics of particles and systems [See also 74H50]

70L10 Stochastic geometric mechanics

70L99 None of the above, but in this section

70Mxx Orbital mechanics

70M20 Orbital mechanics

70M99 None of the above, but in this section

70Pxx Variable mass, rockets

70P05 Variable mass, rockets

70P99 None of the above, but in this section

70Qxx Control of mechanical systems [See also 60Gxx, 60Jxx]

70Q05 Control of mechanical systems

70Q99 None of the above, but in this section
70Sxx Classical field theories [See also 37Kxx, 37Lxx, 78-XX, 81Txx, 83-XX]
70S05 Lagrangian formalism and Hamiltonian formalism in mechanics of particles and systems
70S10 Symmetries and conservation laws in mechanics of particles and systems
70S15 Yang-Mills and other gauge theories in mechanics of particles and systems
70S20 More general nonquantum field theories in mechanics of particles and systems
70S99 None of the above, but in this section

74-XX Mechanics of deformable solids
74-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to mechanics of deformable solids
74-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mechanics of deformable solids
74-02 Research exposition (monographs, survey articles) pertaining to mechanics of deformable solids
74-03 History of mechanics of deformable solids [Consider also classification numbers pertaining to Section 01]
74-04 Software, source code, etc. for problems pertaining to mechanics of deformable solids
74-05 Experimental work for problems pertaining to mechanics of deformable solids
74-06 Proceedings, conferences, collections, etc. pertaining to mechanics of deformable solids
74-10 Mathematical modeling or simulation for problems pertaining to mechanics of deformable solids
74-11 Research data for problems pertaining to mechanics of deformable solids

74Axx Generalities, axiomatics, foundations of continuum mechanics of solids
74A05 Kinematics of deformation
74A10 Stress
74A15 Thermodynamics in solid mechanics
74A20 Theory of constitutive functions in solid mechanics
74A25 Molecular, statistical, and kinetic theories in solid mechanics
74A30 Nonsimple materials
74A35 Polar materials
74A40 Random materials and composite materials
74A45 Theories of fracture and damage
74A50 Structured surfaces and interfaces, coexistent phases
74A55 Theories of friction (tribology)
74A60 Micromechanical theories
74A65 Reactive materials
74A70 Peridynamics
74A99 None of the above, but in this section
### 74Bxx Elastic materials
- **74B05** Classical linear elasticity
- **74B10** Linear elasticity with initial stresses
- **74B15** Equations linearized about a deformed state (small deformations superposed on large)
- **74B20** Nonlinear elasticity
- **74B99** None of the above, but in this section

### 74Cxx Plastic materials, materials of stress-rate and internal-variable type
- **74C05** Small-strain, rate-independent theories of plasticity (including rigid-plastic and elasto-plastic materials)
- **74C10** Small-strain, rate-dependent theories of plasticity (including theories of viscoplasticity)
- **74C15** Large-strain, rate-independent theories of plasticity (including nonlinear plasticity)
- **74C20** Large-strain, rate-dependent theories of plasticity
- **74C99** None of the above, but in this section

### 74Dxx Materials of strain-rate type and history type, other materials with memory (including elastic materials with viscous damping, various viscoelastic materials)
- **74D05** Linear constitutive equations for materials with memory
- **74D10** Nonlinear constitutive equations for materials with memory
- **74D99** None of the above, but in this section

### 74Exx Material properties given special treatment
- **74E05** Inhomogeneity in solid mechanics
- **74E10** Anisotropy in solid mechanics
- **74E15** Crystalline structure
- **74E20** Granularity
- **74E25** Texture in solid mechanics
- **74E30** Composite and mixture properties
- **74E35** Random structure in solid mechanics
- **74E40** Chemical structure in solid mechanics
- **74E99** None of the above, but in this section

### 74Fxx Coupling of solid mechanics with other effects
- **74F05** Thermal effects in solid mechanics
- **74F10** Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
- **74F15** Electromagnetic effects in solid mechanics
- **74F20** Mixture effects in solid mechanics
- **74F25** Chemical and reactive effects in solid mechanics
- **74F99** None of the above, but in this section
74Gxx Equilibrium (steady-state) problems in solid mechanics
74G05 Explicit solutions of equilibrium problems in solid mechanics
74G10 Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of equilibrium problems in solid mechanics
74G15 Numerical approximation of solutions of equilibrium problems in solid mechanics
74G25 Existence of solutions of equilibrium problems in solid mechanics
74G30 Uniqueness of solutions of equilibrium problems in solid mechanics
74G35 Regularity of solutions of equilibrium problems in solid mechanics
74G40 Multiplicity of solutions of equilibrium problems in solid mechanics
74G45 Bounds for solutions of equilibrium problems in solid mechanics
74G50 Saint-Venant’s principle
74G55 Qualitative behavior of solutions of equilibrium problems in solid mechanics
74G60 Bifurcation and buckling
74G65 Energy minimization in equilibrium problems in solid mechanics
74G70 Stress concentrations, singularities in solid mechanics
74G75 Inverse problems in equilibrium solid mechanics
74G99 None of the above, but in this section

74Hxx Dynamical problems in solid mechanics
74H05 Explicit solutions of dynamical problems in solid mechanics
74H10 Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of dynamical problems in solid mechanics
74H15 Numerical approximation of solutions of dynamical problems in solid mechanics
74H20 Existence of solutions of dynamical problems in solid mechanics
74H25 Uniqueness of solutions of dynamical problems in solid mechanics
74H30 Regularity of solutions of dynamical problems in solid mechanics
74H35 Singularities, blow-up, stress concentrations for dynamical problems in solid mechanics
74H40 Long-time behavior of solutions for dynamical problems in solid mechanics
74H45 Vibrations in dynamical problems in solid mechanics
74H50 Random vibrations in dynamical problems in solid mechanics
74H55 Stability of dynamical problems in solid mechanics
74H60 Dynamical bifurcation of solutions to dynamical problems in solid mechanics
74H65 Chaotic behavior of solutions to dynamical problems in solid mechanics
74H75 Inverse problems in dynamical solid mechanics
74H80 Energy minimization in dynamical problems in solid mechanics
74H99 None of the above, but in this section
74Jxx Waves in solid mechanics
74J05 Linear waves in solid mechanics
74J10 Bulk waves in solid mechanics
74J15 Surface waves in solid mechanics
74J20 Wave scattering in solid mechanics
74J25 Inverse problems for waves in solid mechanics
74J30 Nonlinear waves in solid mechanics
74J35 Solitary waves in solid mechanics
74J40 Shocks and related discontinuities in solid mechanics
74J99 None of the above, but in this section

74Kxx Thin bodies, structures
74K05 Strings
74K10 Rods (beams, columns, shafts, arches, rings, etc.)
74K15 Membranes
74K20 Plates
74K25 Shells
74K30 Junctions
74K35 Thin films
74K99 None of the above, but in this section

74Lxx Special subfields of solid mechanics
74L05 Geophysical solid mechanics [See also 86-XX]
74L10 Soil and rock mechanics
74L15 Biomechanical solid mechanics [See also 92C10]
74L99 None of the above, but in this section

74Mxx Special kinds of problems in solid mechanics
74M05 Control, switches and devices (“smart materials”) in solid mechanics [See also 93Cxx]
74M10 Friction in solid mechanics
74M15 Contact in solid mechanics
74M20 Impact in solid mechanics
74M25 Micromechanics of solids
74M99 None of the above, but in this section
74Nxx Phase transformations in solids [See also 74A50, 80Axx, 82B26, 82C26]
74N05 Crystals in solids
74N10 Displacive transformations in solids
74N15 Analysis of microstructure in solids
74N20 Dynamics of phase boundaries in solids
74N25 Transformations involving diffusion in solids
74N30 Problems involving hysteresis in solids
74N99 None of the above, but in this section

74Pxx Optimization problems in solid mechanics [See also 49Qxx]
74P05 Compliance or weight optimization in solid mechanics
74P10 Optimization of other properties in solid mechanics
74P15 Topological methods for optimization problems in solid mechanics
74P20 Geometrical methods for optimization problems in solid mechanics
74P99 None of the above, but in this section

74Qxx Homogenization, determination of effective properties in solid mechanics
74Q05 Homogenization in equilibrium problems of solid mechanics
74Q10 Homogenization and oscillations in dynamical problems of solid mechanics
74Q15 Effective constitutive equations in solid mechanics
74Q20 Bounds on effective properties in solid mechanics
74Q99 None of the above, but in this section

74Rxx Fracture and damage
74R05 Brittle damage
74R10 Brittle fracture
74R15 High-velocity fracture
74R20 Anelastic fracture and damage
74R99 None of the above, but in this section
74Sxx Numerical and other methods in solid mechanics [See also 65-XX, 74G15, 74H15]

74S05 Finite element methods applied to problems in solid mechanics
74S10 Finite volume methods applied to problems in solid mechanics
74S15 Boundary element methods applied to problems in solid mechanics
74S20 Finite difference methods applied to problems in solid mechanics
74S22 Isogeometric methods applied to problems in solid mechanics
74S25 Spectral and related methods applied to problems in solid mechanics
74S30 Other numerical methods applied to problems in solid mechanics
74S40 Applications of fractional calculus in solid mechanics
74S50 Applications of graph theory in solid mechanics
74S60 Stochastic and other probabilistic methods applied to problems in solid mechanics
74S70 Complex-variable methods applied to problems in solid mechanics
74S99 None of the above, but in this section

76-XX Fluid mechanics {For general continuum mechanics, see 74Axx, or other parts of 74-XX}

76-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to fluid mechanics
76-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to fluid mechanics
76-02 Research exposition (monographs, survey articles) pertaining to fluid mechanics
76-03 History of fluid mechanics [Consider also classification numbers pertaining to Section 01]
76-04 Software, source code, etc. for problems pertaining to fluid mechanics
76-05 Experimental work for problems pertaining to fluid mechanics
76-06 Proceedings, conferences, collections, etc. pertaining to fluid mechanics
76-10 Mathematical modeling or simulation for problems pertaining to fluid mechanics
76-11 Research data for problems pertaining to fluid mechanics

76Axx Foundations, constitutive equations, rheology, hydrodynamical models of non-fluid phenomena

76A02 Foundations of fluid mechanics
76A05 Non-Newtonian fluids
76A10 Viscoelastic fluids
76A15 Liquid crystals [See also 82D30]
76A20 Thin fluid films
76A25 Superfluids (classical aspects)
76A30 Traffic and pedestrian flow models
76A99 None of the above, but in this section
76Bxx Incompressible inviscid fluids
76B03  Existence, uniqueness, and regularity theory for incompressible inviscid fluids [See also 35Q35]
76B07  Free-surface potential flows for incompressible inviscid fluids
76B10  Jets and cavities, cavitation, free-streamline theory, water-entry problems, airfoil and hydrofoil theory, sloshing
76B15  Water waves, gravity waves; dispersion and scattering, nonlinear interaction [See also 35Q30]
76B20  Ship waves
76B25  Solitary waves for incompressible inviscid fluids [See also 35C11]
76B45  Capillarity (surface tension) for incompressible inviscid fluids [See also 76D45]
76B47  Vortex flows for incompressible inviscid fluids
76B55  Internal waves for incompressible inviscid fluids
76B70  Stratification effects in inviscid fluids
76B75  Flow control and optimization for incompressible inviscid fluids [See also 49Q10, 93C20, 93C95]
76B99  None of the above, but in this section

76Dxx Incompressible viscous fluids
76D03  Existence, uniqueness, and regularity theory for incompressible viscous fluids [See also 35Q30]
76D05  Navier-Stokes equations for incompressible viscous fluids [See also 35Q30]
76D06  Statistical solutions of Navier-Stokes and related equations [See also 60H30, 76M35]
76D07  Stokes and related (Oseen, etc.) flows
76D08  Lubrication theory
76D09  Viscous-inviscid interaction
76D10  Boundary-layer theory, separation and reattachment, higher-order effects
76D17  Viscous vortex flows
76D25  Wakes and jets
76D27  Other free boundary flows; Hele-Shaw flows
76D33  Waves for incompressible viscous fluids
76D45  Capillarity (surface tension) for incompressible viscous fluids [See also 76B45]
76D50  Stratification effects in viscous fluids
76D55  Flow control and optimization for incompressible viscous fluids [See also 49Q10, 93C20, 93C95]
76D99  None of the above, but in this section

189
76Exx Hydrodynamic stability
76E05 Parallel shear flows in hydrodynamic stability
76E06 Convection in hydrodynamic stability
76E07 Rotation in hydrodynamic stability
76E09 Stability and instability of nonparallel flows in hydrodynamic stability
76E15 Absolute and convective instability and stability in hydrodynamic stability
76E17 Interfacial stability and instability in hydrodynamic stability
76E19 Compressibility effects in hydrodynamic stability
76E20 Stability and instability of geophysical and astrophysical flows
76E25 Stability and instability of magnetohydrodynamic and electrohydrodynamic flows
76E30 Nonlinear effects in hydrodynamic stability
76E99 None of the above, but in this section

76Fxx Turbulence [See also 37-XX, 60Gxx, 60Jxx]
76F02 Fundamentals of turbulence
76F05 Isotropic turbulence; homogeneous turbulence
76F06 Transition to turbulence
76F10 Shear flows and turbulence
76F20 Dynamical systems approach to turbulence [See also 37-XX]
76F25 Turbulent transport, mixing
76F30 Renormalization and other field-theoretical methods for turbulence [See also 81T99]
76F35 Convective turbulence [See also 76E15, 76Rxx]
76F40 Turbulent boundary layers
76F45 Stratification effects in turbulence
76F50 Compressibility effects in turbulence
76F55 Statistical turbulence modeling [See also 76M35]
76F60 $k$-$\varepsilon$ modeling in turbulence
76F65 Direct numerical and large eddy simulation of turbulence
76F70 Control of turbulent flows
76F80 Turbulent combustion; reactive turbulence
76F99 None of the above, but in this section

76Gxx General aerodynamics and subsonic flows
76G25 General aerodynamics and subsonic flows
76G99 None of the above, but in this section
76Hxx Transonic flows
76H05 Transonic flows
76H99 None of the above, but in this section

76Jxx Supersonic flows
76J20 Supersonic flows
76J99 None of the above, but in this section

76Kxx Hypersonic flows
76K05 Hypersonic flows
76K99 None of the above, but in this section

76Lxx Shock waves and blast waves in fluid mechanics [See also 35L67]
76L05 Shock waves and blast waves in fluid mechanics [See also 35L67]
76L99 None of the above, but in this section

76Mxx Basic methods in fluid mechanics [See also 65-XX]
76M10 Finite element methods applied to problems in fluid mechanics
76M12 Finite volume methods applied to problems in fluid mechanics
76M15 Boundary element methods applied to problems in fluid mechanics
76M20 Finite difference methods applied to problems in fluid mechanics
76M21 Inverse problems in fluid mechanics
76M22 Spectral methods applied to problems in fluid mechanics
76M23 Vortex methods applied to problems in fluid mechanics
76M25 Other numerical methods applied to problems in fluid mechanics
76M27 Visualization algorithms applied to problems in fluid mechanics
76M28 Particle methods and lattice-gas methods
76M30 Variational methods applied to problems in fluid mechanics
76M35 Stochastic analysis applied to problems in fluid mechanics
76M40 Complex variables methods applied to problems in fluid mechanics
76M45 Asymptotic methods, singular perturbations applied to problems in fluid mechanics
76M50 Homogenization applied to problems in fluid mechanics
76M55 Dimensional analysis and similarity applied to problems in fluid mechanics
76M60 Symmetry analysis, Lie group and Lie algebra methods applied to problems in fluid mechanics
76M99 None of the above, but in this section
76Nxx Compressible fluids and gas dynamics, general
76N05 Compressible Navier-Stokes equations
76N10 Existence, uniqueness, and regularity theory for compressible fluids and gas dynamics [See also 35L60, 35L65, 35Q30]
76N15 Gas dynamics, general
76N17 Viscous-inviscid interaction for compressible fluids and gas dynamics
76N20 Boundary-layer theory for compressible fluids and gas dynamics
76N25 Flow control and optimization for compressible fluids and gas dynamics
76N30 Waves in compressible fluids
76N99 None of the above, but in this section

76Pxx Rarefied gas flows, Boltzmann equation in fluid mechanics [See also 82B40, 82C40, 82D05]
76P05 Rarefied gas flows, Boltzmann equation in fluid mechanics [See also 82B40, 82C40, 82D05]
76P99 None of the above, but in this section

76Qxx Hydro- and aero-acoustics
76Q05 Hydro- and aero-acoustics
76Q99 None of the above, but in this section

76Rxx Diffusion and convection
76R05 Forced convection
76R10 Free convection
76R50 Diffusion [See also 60J60]
76R99 None of the above, but in this section

76Sxx Flows in porous media; filtration; seepage
76S05 Flows in porous media; filtration; seepage
76S99 None of the above, but in this section

76Txx Multiphase and multicomponent flows
76T05 Liquid-liquid two component flows
76T10 Liquid-gas two-phase flows, bubbly flows
76T15 Dusty-gas two-phase flows
76T17 Two gas multicomponent flows
76T20 Suspensions
76T25 Granular flows [See also 74C99, 74E20]
76T30 Three or more component flows
76T99 None of the above, but in this section
76Uxx Rotating fluids
76U05 Rotating fluids
76U60 Geophysical flows [See also 86A05, 86A10]
76U65 Rossby waves [See also 86A05, 86A10]
76U99 None of the above, but in this section

76Vxx Reaction effects in flows [See also 80A32]
76V05 Reaction effects in flows [See also 80A32]
76V99 None of the above, but in this section

76Wxx Magnetohydrodynamics and electrohydrodynamics
76W05 Magnetohydrodynamics and electrohydrodynamics
76W99 None of the above, but in this section

76Xxx Ionized gas flow in electromagnetic fields; plasmic flow [See also 82D10]
76X05 Ionized gas flow in electromagnetic fields; plasmic flow [See also 82D10]
76X99 None of the above, but in this section

76Yxx Quantum hydrodynamics and relativistic hydrodynamics [See also 82D50, 83C55, 85A30]
76Y05 Quantum hydrodynamics and relativistic hydrodynamics [See also 82D50, 83C55, 85A30]
76Y99 None of the above, but in this section

76Zxx Biological fluid mechanics [See also 74F10, 74L15, 92Cxx]
76Z05 Physiological flows [See also 92C35]
76Z10 Biopropulsion in water and in air
76Z99 None of the above, but in this section

78-XX Optics, electromagnetic theory {For quantum optics, see 81V80}
78-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to optics and electromagnetic theory
78-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to optics and electromagnetic theory
78-02 Research exposition (monographs, survey articles) pertaining to optics and electromagnetic theory
78-03 History of optics and electromagnetic theory [Consider also classification numbers pertaining to Section 01]
78-04 Software, source code, etc. for problems pertaining to optics and electromagnetic theory
78-05 Experimental work for problems pertaining to optics and electromagnetic theory
78-06 Proceedings, conferences, collections, etc. pertaining to optics and electromagnetic theory
78-10 Mathematical modeling or simulation for problems pertaining to optics and electromagnetic theory
78-11 Research data for problems pertaining to optics and electromagnetic theory
78Axx General
78A02 Foundations in optics and electromagnetic theory
78A05 Geometric optics
78A10 Physical optics
78A15 Electron optics
78A20 Space charge waves
78A25 Electromagnetic theory, general
78A30 Electro- and magnetostatics
78A35 Motion of charged particles
78A37 Ion traps
78A40 Waves and radiation in optics and electromagnetic theory
78A45 Diffraction, scattering {For WKB methods see 34E20}
78A46 Inverse problems (including inverse scattering) in optics and electromagnetic theory
78A48 Composite media; random media in optics and electromagnetic theory
78A50 Antennas, waveguides in optics and electromagnetic theory
78A55 Technical applications of optics and electromagnetic theory
78A57 Electrochemistry
78A60 Lasers, masers, optical bistability, nonlinear optics [See also 81V80]
78A70 Biological applications of optics and electromagnetic theory [See also 91D30, 92C30]
78A97 Mathematically heuristic optics and electromagnetic theory (must also be assigned at least one other classification number in Section 78)
78A99 None of the above, but in this section

78Mxx Basic methods for problems in optics and electromagnetic theory [See also 65-XX]
78M05 Method of moments applied to problems in optics and electromagnetic theory
78M10 Finite element, Galerkin and related methods applied to problems in optics and electromagnetic theory
78M12 Finite volume methods, finite integration techniques applied to problems in optics and electromagnetic theory
78M15 Boundary element methods applied to problems in optics and electromagnetic theory
78M16 Multipole methods applied to problems in optics and electromagnetic theory
78M20 Finite difference methods applied to problems in optics and electromagnetic theory
78M22 Spectral, collocation and related methods applied to problems in optics and electromagnetic theory
78M25 Other numerical methods applied to problems in optics and electromagnetic theory
78M30 Variational methods applied to problems in optics and electromagnetic theory
78M31 Monte Carlo methods applied to problems in optics and electromagnetic theory
78M32 Neural and heuristic methods applied to problems in optics and electromagnetic theory
78M34 Model reduction in optics and electromagnetic theory
78M35 Asymptotic analysis in optics and electromagnetic theory
78M40 Homogenization in optics and electromagnetic theory
78M50 Optimization problems in optics and electromagnetic theory
78M99 None of the above, but in this section

80-XX Classical thermodynamics, heat transfer {For thermodynamics of solids, see 74A15}

80-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to classical thermodynamics
80-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to classical thermodynamics
80-02 Research exposition (monographs, survey articles) pertaining to classical thermodynamics
80-03 History of classical thermodynamics [Consider also classification numbers pertaining to Section 01]
80-04 Software, source code, etc. for problems pertaining to classical thermodynamics
80-05 Experimental work for problems pertaining to classical thermodynamics
80-06 Proceedings, conferences, collections, etc. pertaining to classical thermodynamics
80-10 Mathematical modeling or simulation for problems pertaining to classical thermodynamics
80-11 Research data for problems pertaining to classical thermodynamics

80Axx Thermodynamics and heat transfer

80A05 Foundations of thermodynamics and heat transfer
80A10 Classical and relativistic thermodynamics
80A17 Thermodynamics of continua [See also 74A15]
80A20 Diffusive and convective heat and mass transfer, heat flow
80A22 Stefan problems, phase changes, etc. [See also 74Nxx]
80A23 Inverse problems in thermodynamics and heat transfer
80A25 Combustion
80A30 Chemical kinetics in thermodynamics and heat transfer [See also 76V05, 92C45, 92E20]
80A32 Chemically reacting flows [See also 92C45, 92E20]
80A50 Chemistry (general) in thermodynamics and heat transfer [See mainly 92Exx]
80A60 Radiative heat transfer
80A99 None of the above, but in this section
80Mxx Basic methods in thermodynamics and heat transfer [See also 65-XX]

80M10 Finite element, Galerkin and related methods applied to problems in thermodynamics and heat transfer

80M12 Finite volume methods applied to problems in thermodynamics and heat transfer

80M15 Boundary element methods applied to problems in thermodynamics and heat transfer

80M20 Finite difference methods applied to problems in thermodynamics and heat transfer

80M22 Spectral, collocation and related (meshless) methods applied to problems in thermodynamics and heat transfer

80M25 Other numerical methods applied to problems in thermodynamics and heat transfer

80M30 Variational methods applied to problems in thermodynamics and heat transfer

80M31 Monte Carlo methods applied to problems in thermodynamics and heat transfer

80M35 Asymptotic analysis for problems in thermodynamics and heat transfer

80M40 Homogenization for problems in thermodynamics and heat transfer

80M50 Optimization problems in thermodynamics and heat transfer

80M60 Stochastic analysis in thermodynamics and heat transfer

80M99 None of the above, but in this section

81-XX Quantum theory

81-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to quantum theory

81-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to quantum theory

81-02 Research exposition (monographs, survey articles) pertaining to quantum theory

81-03 History of quantum theory [Consider also classification numbers pertaining to Section 01]

81-04 Software, source code, etc. for problems pertaining to quantum theory

81-05 Experimental work for problems pertaining to quantum theory

81-06 Proceedings, conferences, collections, etc. pertaining to quantum theory

81-08 Computational methods for problems pertaining to quantum theory

81-10 Mathematical modeling or simulation for problems pertaining to quantum theory

81-11 Research data for problems pertaining to quantum theory

81Pxx Foundations, quantum information and its processing, quantum axioms, and philosophy

81P05 General and philosophical questions in quantum theory

81P10 Logical foundations of quantum mechanics; quantum logic (quantum-theoretic aspects) [See also 03G12, 06C15]

81P13 Contextuality in quantum theory

81P15 Quantum measurement theory, state operations, state preparations
81P16 Quantum state spaces, operational and probabilistic concepts
81P17 Quantum entropies
81P18 Quantum state tomography, quantum state discrimination
81P20 Stochastic mechanics (including stochastic electrodynamics)
81P40 Quantum coherence, entanglement, quantum correlations
81P42 Entanglement measures, concurrences, separability criteria
81P43 Quantum discord
81P45 Quantum information, communication, networks (quantum-theoretic aspects) [See also 94A15, 94A17]
81P47 Quantum channels, fidelity [See also 94A40]
81P48 LOCC, teleportation, dense coding, remote state operations, distillation
81P50 Quantum state estimation, approximate cloning
81P55 Special bases (entangled, mutual unbiased, etc.)
81P65 Quantum gates
81P68 Quantum computation [See also 68Q09] {For algorithmic aspects, see 68Q12}
81P70 Quantum coding (general)
81P73 Computational stability and error-correcting codes for quantum computation and communication processing
81P94 Quantum cryptography (quantum-theoretic aspects) [See also 94A60]
81P99 None of the above, but in this section

81Qxx General mathematical topics and methods in quantum theory
81Q05 Closed and approximate solutions to the Schrödinger, Dirac, Klein-Gordon and other equations of quantum mechanics
81Q10 Selfadjoint operator theory in quantum theory, including spectral analysis
81Q12 Nonselfadjoint operator theory in quantum theory including creation and destruction operators
81Q15 Perturbation theories for operators and differential equations in quantum theory
81Q20 Semiclassical techniques, including WKB and Maslov methods applied to problems in quantum theory
81Q30 Feynman integrals and graphs; applications of algebraic topology and algebraic geometry [See also 14D05, 32S40]
81Q35 Quantum mechanics on special spaces: manifolds, fractals, graphs, lattices [See also 81R20]
81Q37 Quantum dots, waveguides, ratchets, etc. [See also 82D20, 82D77]
81Q40 Bethe-Salpeter and other integral equations arising in quantum theory
81Q50 Quantum chaos [See also 37Dxx]
81Q60 Supersymmetry and quantum mechanics
81Q65 Alternative quantum mechanics (including hidden variables, etc.)
81Q70 differential geometric methods, including holonomy, Berry and Hannay phases, Aharonov-Bohm effect, etc.
in quantum theory

81Q80 Special quantum systems, such as solvable systems

81Q93 Quantum control

81Q99 None of the above, but in this section

81Rxx Groups and algebras in quantum theory

81R05 Finite-dimensional groups and algebras motivated by physics and their representations [See also 20C35, 22E70]

81R10 Infinite-dimensional groups and algebras motivated by physics, including Virasoro, Kac-Moody, W-algebras and other current algebras and their representations [See also 17B65, 17B67, 22E65, 22E67, 22E70]

81R12 Groups and algebras in quantum theory and relations with integrable systems [See also 17Bxx, 37J35]

81R15 Operator algebra methods applied to problems in quantum theory [See also 46Lxx, 81T05]

81R20 Covariant wave equations in quantum theory, relativistic quantum mechanics [See also 81Q35]

81R25 Spinor and twistor methods applied to problems in quantum theory [See also 32L25]

81R30 Coherent states [See also 22E45]; squeezed states in quantum theory [See also 81V80]

81R40 Symmetry breaking in quantum theory

81R50 Quantum groups and related algebraic methods applied to problems in quantum theory [See also 16T20, 17B37]

81R60 Noncommutative geometry in quantum theory

81R99 None of the above, but in this section

81Sxx General quantum mechanics and problems of quantization

81S05 Commutation relations and statistics as related to quantum mechanics (general)

81S07 Uncertainty relations, also entropic

81S08 Canonical quantization

81S10 Geometry and quantization, symplectic methods [See also 53D50]

81S20 Stochastic quantization

81S22 Open systems, reduced dynamics, master equations, decoherence [See also 82C31]

81S25 Quantum stochastic calculus

81S30 Phase-space methods including Wigner distributions, etc. applied to problems in quantum mechanics

81S40 Path integrals in quantum mechanics [See also 58D30, 81Q30, 81T18]

81S99 None of the above, but in this section
81Txx Quantum field theory; related classical field theories [See also 70Sxx]

81T05 Axiomatic quantum field theory; operator algebras

81T08 Constructive quantum field theory

81T10 Model quantum field theories

81T11 Higher spin theories

81T12 Effective quantum field theories

81T13 Yang-Mills and other gauge theories in quantum field theory [See also 53C07, 58E15]

81T15 Perturbative methods of renormalization applied to problems in quantum field theory

81T16 Nonperturbative methods of renormalization applied to problems in quantum field theory

81T17 Renormalization group methods applied to problems in quantum field theory

81T18 Feynman diagrams

81T20 Quantum field theory on curved space or space-time backgrounds

81T25 Quantum field theory on lattices

81T27 Continuum limits in quantum field theory

81T28 Thermal quantum field theory [See also 82B30]

81T30 String and superstring theories; other extended objects (e.g., branes) in quantum field theory [See also 83E30]

81T32 Matrix models and tensor models for quantum field theory

81T33 Dimensional compactification in quantum field theory

81T35 Correspondence, duality, holography (ADS/CFT, gauge/gravity, etc.) [See also 83E05]

81T40 Two-dimensional field theories, conformal field theories, etc. in quantum mechanics

81T45 Topological field theories in quantum mechanics [See also 57R56, 58Dxx]

81T50 Anomalies in quantum field theory

81T55 Casimir effect in quantum field theory

81T60 Supersymmetric field theories in quantum mechanics

81T70 Quantization in field theory; cohomological methods [See also 58D29]

81T75 Noncommutative geometry methods in quantum field theory [See also 46L85, 46L87, 58B34]

81T99 None of the above, but in this section
### 81Uxx Quantum scattering theory

[See also 34A55, 34L25, 34L40, 35P25, 47A40]

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>81U05</td>
<td>2-body potential quantum scattering theory {For WKB methods, see also 34E20}</td>
</tr>
<tr>
<td>81U10</td>
<td>$n$-body potential quantum scattering theory</td>
</tr>
<tr>
<td>81U15</td>
<td>Exactly and quasi-solvable systems arising in quantum theory</td>
</tr>
<tr>
<td>81U20</td>
<td>$S$-matrix theory, etc. in quantum theory</td>
</tr>
<tr>
<td>81U24</td>
<td>Resonances in quantum scattering theory</td>
</tr>
<tr>
<td>81U26</td>
<td>Tunneling in quantum theory</td>
</tr>
<tr>
<td>81U30</td>
<td>Dispersion theory, dispersion relations arising in quantum theory</td>
</tr>
<tr>
<td>81U35</td>
<td>Inelastic and multichannel quantum scattering</td>
</tr>
<tr>
<td>81U40</td>
<td>Inverse scattering problems in quantum theory</td>
</tr>
<tr>
<td>81U90</td>
<td>Particle decays in scattering</td>
</tr>
<tr>
<td>81U99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

### 81Vxx Applications of quantum theory to specific physical systems

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>81V05</td>
<td>Strong interaction, including quantum chromodynamics</td>
</tr>
<tr>
<td>81V10</td>
<td>Electromagnetic interaction; quantum electrodynamics</td>
</tr>
<tr>
<td>81V15</td>
<td>Weak interaction in quantum theory</td>
</tr>
<tr>
<td>81V17</td>
<td>Gravitational interaction in quantum theory [See also 83Cxx, 83Exx]</td>
</tr>
<tr>
<td>81V19</td>
<td>Other fundamental interactions in quantum theory</td>
</tr>
<tr>
<td>81V22</td>
<td>Unified quantum theories</td>
</tr>
<tr>
<td>81V25</td>
<td>Other elementary particle theory in quantum theory</td>
</tr>
<tr>
<td>81V27</td>
<td>Anyons</td>
</tr>
<tr>
<td>81V35</td>
<td>Nuclear physics</td>
</tr>
<tr>
<td>81V45</td>
<td>Atomic physics</td>
</tr>
<tr>
<td>81V55</td>
<td>Molecular physics [See also 92E10]</td>
</tr>
<tr>
<td>81V60</td>
<td>Mono-, di- and multipole moments (EM and other), gyromagnetic relations</td>
</tr>
<tr>
<td>81V65</td>
<td>Quantum dots as quasi particles [See also 82D20]</td>
</tr>
<tr>
<td>81V70</td>
<td>Many-body theory; quantum Hall effect</td>
</tr>
<tr>
<td>81V72</td>
<td>Particle exchange symmetries in quantum theory (general)</td>
</tr>
<tr>
<td>81V73</td>
<td>Bosonic systems in quantum theory</td>
</tr>
<tr>
<td>81V74</td>
<td>Fermionic systems in quantum theory</td>
</tr>
<tr>
<td>81V80</td>
<td>Quantum optics</td>
</tr>
<tr>
<td>81V99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
### 82-XX Statistical mechanics, structure of matter

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>82-00</td>
<td>General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-01</td>
<td>Introductory exposition (textbooks, tutorial papers, etc.) pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-02</td>
<td>Research exposition (monographs, survey articles) pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-03</td>
<td>History of statistical mechanics [Consider also classification numbers pertaining to Section 01]</td>
</tr>
<tr>
<td>82-04</td>
<td>Software, source code, etc. for problems pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-05</td>
<td>Experimental work for problems pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-06</td>
<td>Proceedings, conferences, collections, etc. pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-10</td>
<td>Mathematical modeling or simulation for problems pertaining to statistical mechanics</td>
</tr>
<tr>
<td>82-11</td>
<td>Research data for problems pertaining to statistical mechanics</td>
</tr>
</tbody>
</table>

### 82Bxx Equilibrium statistical mechanics

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>82B03</td>
<td>Foundations of equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B05</td>
<td>Classical equilibrium statistical mechanics (general)</td>
</tr>
<tr>
<td>82B10</td>
<td>Quantum equilibrium statistical mechanics (general)</td>
</tr>
<tr>
<td>82B20</td>
<td>Lattice systems (Ising, dimer, Potts, etc.) and systems on graphs arising in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B21</td>
<td>Continuum models (systems of particles, etc.) arising in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B23</td>
<td>Exactly solvable models; Bethe ansatz</td>
</tr>
<tr>
<td>82B24</td>
<td>Interface problems; diffusion-limited aggregation arising in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B26</td>
<td>Phase transitions (general) in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B27</td>
<td>Critical phenomena in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B28</td>
<td>Renormalization group methods in equilibrium statistical mechanics [See also 81T17]</td>
</tr>
<tr>
<td>82B30</td>
<td>Statistical thermodynamics [See also 80-XX]</td>
</tr>
<tr>
<td>82B31</td>
<td>Stochastic methods applied to problems in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B35</td>
<td>Irreversible thermodynamics, including Onsager-Machlup theory [See also 92E20]</td>
</tr>
<tr>
<td>82B40</td>
<td>Kinetic theory of gases in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B41</td>
<td>Random walks, random surfaces, lattice animals, etc. in equilibrium statistical mechanics [See also 60G50, 82C41]</td>
</tr>
<tr>
<td>82B43</td>
<td>Percolation [See also 60K35]</td>
</tr>
<tr>
<td>82B44</td>
<td>Disordered systems (random Ising models, random Schrödinger operators, etc.) in equilibrium statistical mechanics</td>
</tr>
<tr>
<td>82B99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>
82Cxx Time-dependent statistical mechanics (dynamic and nonequilibrium)

82C03 Foundations of time-dependent statistical mechanics

82C05 Classical dynamic and nonequilibrium statistical mechanics (general)

82C10 Quantum dynamics and nonequilibrium statistical mechanics (general)

82C20 Dynamic lattice systems (kinetic Ising, etc.) and systems on graphs in time-dependent statistical mechanics

82C21 Dynamic continuum models (systems of particles, etc.) in time-dependent statistical mechanics

82C22 Interacting particle systems in time-dependent statistical mechanics [See also 60K35]

82C23 Exactly solvable dynamic models in time-dependent statistical mechanics [See also 37K60]

82C24 Interface problems; diffusion-limited aggregation in time-dependent statistical mechanics

82C26 Dynamic and nonequilibrium phase transitions (general) in statistical mechanics

82C27 Dynamic critical phenomena in statistical mechanics

82C28 Dynamic renormalization group methods applied to problems in time-dependent statistical mechanics [See also 81T17]

82C31 Stochastic methods (Fokker-Planck, Langevin, etc.) applied to problems in time-dependent statistical mechanics [See also 60H10]

82C32 Neural nets applied to problems in time-dependent statistical mechanics [See also 68T05, 91E40, 92B20]

82C35 Irreversible thermodynamics, including Onsager-Machlup theory

82C40 Kinetic theory of gases in time-dependent statistical mechanics

82C41 Dynamics of random walks, random surfaces, lattice animals, etc. in time-dependent statistical mechanics [See also 60G50]

82C43 Time-dependent percolation in statistical mechanics [See also 60K35]

82C44 Dynamics of disordered systems (random Ising systems, etc.) in time-dependent statistical mechanics

82C70 Transport processes in time-dependent statistical mechanics

82C99 None of the above, but in this section

82Dxx Applications of statistical mechanics to specific types of physical systems

82D03 Statistical mechanical studies in condensed matter (general)

82D05 Statistical mechanical studies of gases

82D10 Statistical mechanical studies of plasmas

82D15 Statistical mechanical studies of liquids

82D20 Statistical mechanical studies of solids

82D25 Statistical mechanical studies of crystals {For crystallographic group theory, see 20H15}

82D30 Statistical mechanical studies of random media, disordered materials (including liquid crystals and spin glasses)

82D35 Statistical mechanical studies of metals
82D37 Statistical mechanical studies of semiconductors
82D40 Statistical mechanical studies of magnetic materials
82D45 Statistical mechanical studies of ferroelectrics
82D50 Statistical mechanical studies of superfluids
82D55 Statistical mechanical studies of superconductors
82D60 Statistical mechanical studies of polymers
82D75 Nuclear reactor theory; neutron transport
82D77 Quantum waveguides, quantum wires [See also 78A50]
82D80 Statistical mechanical studies of nanostructures and nanoparticles
82D99 None of the above, but in this section

82Mxx Basic methods in statistical mechanics [See also 65-XX]
82M10 Finite element, Galerkin and related methods applied to problems in statistical mechanics
82M12 Finite volume methods applied to problems in statistical mechanics
82M15 Boundary element methods applied to problems in statistical mechanics
82M20 Finite difference methods applied to problems in statistical mechanics
82M22 Spectral, collocation and related (meshless) methods applied to problems in statistical mechanics
82M25 Other numerical methods applied to problems in statistical mechanics
82M30 Variational methods applied to problems in statistical mechanics
82M31 Monte Carlo methods applied to problems in statistical mechanics [See also 65C05]
82M36 Computational density functional analysis in statistical mechanics
82M37 Computational molecular dynamics in statistical mechanics
82M60 Stochastic analysis in statistical mechanics [See also 65C35]
82M99 None of the above, but in this section

83-XX Relativity and gravitational theory
83-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to relativity and gravitational theory
83-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to relativity and gravitational theory
83-02 Research exposition (monographs, survey articles) pertaining to relativity and gravitational theory
83-03 History of relativity and gravitational theory [Consider also classification numbers pertaining to Section 01]
83-04 Software, source code, etc. for problems pertaining to relativity and gravitational theory
83-05 Experimental work for problems pertaining to relativity and gravitational theory
83-06 Proceedings, conferences, collections, etc. pertaining to relativity and gravitational theory
83-08 Computational methods for problems pertaining to relativity and gravitational theory
83-10 Mathematical modeling or simulation for problems pertaining to relativity and gravitational theory
83-11 Research data for problems pertaining to relativity and gravitational theory

203
83Axx Special relativity
83A05 Special relativity
83A99 None of the above, but in this section

83Bxx Observational and experimental questions in relativity and gravitational theory
83B05 Observational and experimental questions in relativity and gravitational theory
83B99 None of the above, but in this section

83Cxx General relativity
83C05 Einstein’s equations (general structure, canonical formalism, Cauchy problems)
83C10 Equations of motion in general relativity and gravitational theory
83C15 Exact solutions to problems in general relativity and gravitational theory
83C20 Classes of solutions; algebraically special solutions, metrics with symmetries for problems in general relativity and gravitational theory
83C22 Einstein-Maxwell equations
83C25 Approximation procedures, weak fields in general relativity and gravitational theory
83C27 Lattice gravity, Regge calculus and other discrete methods in general relativity and gravitational theory
83C30 Asymptotic procedures (radiation, news functions, H-spaces, etc.) in general relativity and gravitational theory
83C35 Gravitational waves
83C40 Gravitational energy and conservation laws; groups of motions
83C45 Quantization of the gravitational field
83C47 Methods of quantum field theory in general relativity and gravitational theory [See also 81T20]
83C50 Electromagnetic fields in general relativity and gravitational theory
83C55 Macroscopic interaction of the gravitational field with matter (hydrodynamics, etc.)
83C56 Dark matter and dark energy
83C57 Black holes
83C60 Spinor and twistor methods in general relativity and gravitational theory; Newman-Penrose formalism
83C65 Methods of noncommutative geometry in general relativity [See also 58B34]
83C75 Space-time singularities, cosmic censorship, etc.
83C80 Analogues of general relativity in lower dimensions
83C99 None of the above, but in this section

83Dxx Relativistic gravitational theories other than Einstein’s, including asymmetric field theories
83D05 Relativistic gravitational theories other than Einstein’s, including asymmetric field theories
83D99 None of the above, but in this section
83Exx Unified, higher-dimensional and super field theories
83E05 Geometrodynamics and the holographic principle [See also 81T35]
83E15 Kaluza-Klein and other higher-dimensional theories
83E30 String and superstring theories in gravitational theory [See also 81T30]
83E50 Supergravity
83E99 None of the above, but in this section

83Fxx Cosmology
83F05 Cosmology
83F99 None of the above, but in this section

85-XX Astronomy and astrophysics {For celestial mechanics, see 70F15}
85-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to astronomy and astrophysics
85-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to astronomy and astrophysics
85-02 Research exposition (monographs, survey articles) pertaining to astronomy and astrophysics
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85-08 Computational methods for problems pertaining to astronomy and astrophysics
85-10 Mathematical modeling or simulation for problems pertaining to astronomy and astrophysics
85-11 Research data for problems pertaining to astronomy and astrophysics

85Axx Astronomy and astrophysics {For celestial mechanics, see 70F15}
85A04 General questions in astronomy and astrophysics
85A05 Galactic and stellar dynamics
85A15 Galactic and stellar structure
85A20 Planetary atmospheres
85A25 Radiative transfer in astronomy and astrophysics
85A30 Hydrodynamic and hydromagnetic problems in astronomy and astrophysics [See also 76Y05]
85A35 Statistical astronomy
85A40 Cosmology {For relativistic cosmology, see 83F05}
85A99 None of the above, but in this section
86-XX Geophysics [See also 76U05, 76V05]

86-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to geophysics
86-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to geophysics
86-02 Research exposition (monographs, survey articles) pertaining to geophysics
86-03 History of geophysics [Consider also classification numbers pertaining to Section 01]
86-04 Software, source code, etc. for problems pertaining to geophysics
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86-08 Computational methods for problems pertaining to geophysics
86-10 Mathematical modeling or simulation for problems pertaining to geophysics
86-11 Research data for problems pertaining to geophysics

86Axx Geophysics [See also 76U05, 76V05]

86A04 General questions in geophysics
86A05 Hydrology, hydrography, oceanography [See also 76Bxx, 76E20, 76Q05, 76Rxx, 76U05]
86A08 Climate science and climate modeling
86A10 Meteorology and atmospheric physics [See also 76Bxx, 76E20, 76N15, 76Q05, 76Rxx, 76U05]
86A15 Seismology (including tsunami modeling), earthquakes
86A20 Potentials, prospecting
86A22 Inverse problems in geophysics [See also 35R30]
86A25 Geo-electricity and geomagnetism [See also 76W05, 78A25]
86A30 Geodesy, mapping problems
86A32 Geostatistics
86A40 Glaciology
86A60 Geological problems
86A70 Vulcanology; magma and lava flow
86A99 None of the above, but in this section
90-XX Operations research, mathematical programming

90-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to operations research and mathematical programming

90-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to operations research and mathematical programming

90-02 Research exposition (monographs, survey articles) pertaining to operations research and mathematical programming

90-03 History of operations research and mathematical programming [Consider also classification numbers pertaining to Section 01]

90-04 Software, source code, etc. for problems pertaining to operations research and mathematical programming

90-05 Experimental work for problems pertaining to operations research and mathematical programming

90-06 Proceedings, conferences, collections, etc. pertaining to operations research and mathematical programming

90-08 Computational methods for problems pertaining to operations research and mathematical programming

90-10 Mathematical modeling or simulation for problems pertaining to operations research and mathematical programming

90-11 Research data for problems pertaining to operations research and mathematical programming

90Bxx Operations research and management science

90B05 Inventory, storage, reservoirs

90B06 Transportation, logistics and supply chain management

90B10 Deterministic network models in operations research {For network control, see 93B70}

90B15 Stochastic network models in operations research {For network control, see 93B70}

90B18 Communication networks in operations research [See also 68M10, 68M12, 68M18, 94A05] {For networks as computational models, see 68Q06}

90B20 Traffic problems in operations research

90B22 Queues and service in operations research [See also 60K25, 68M20]

90B25 Reliability, availability, maintenance, inspection in operations research [See also 60K10, 62N05]

90B30 Production models

90B35 Deterministic scheduling theory in operations research [See also 68M20]

90B36 Stochastic scheduling theory in operations research [See also 68M20]

90B40 Search theory

90B50 Management decision making, including multiple objectives [See also 90C29, 90C31, 91A35, 91B06]

90B60 Marketing, advertising [See also 91B60]

90B70 Theory of organizations, manpower planning in operations research [See also 91D35]

90B80 Discrete location and assignment [See also 90C10]

90B85 Continuous location

90B90 Case-oriented studies in operations research

90B99 None of the above, but in this section
90Cxx Mathematical programming [See also 49Mxx, 65Kxx]

90C05 Linear programming
90C06 Large-scale problems in mathematical programming
90C08 Special problems of linear programming (transportation, multi-index, data envelopment analysis, etc.)
90C09 Boolean programming
90C10 Integer programming
90C11 Mixed integer programming
90C15 Stochastic programming
90C17 Robustness in mathematical programming
90C20 Quadratic programming
90C22 Semidefinite programming
90C23 Polynomial optimization
90C24 Tropical optimization (e.g., max-plus optimization)
90C25 Convex programming
90C26 Nonconvex programming, global optimization
90C27 Combinatorial optimization
90C29 Multi-objective and goal programming
90C30 Nonlinear programming
90C31 Sensitivity, stability, parametric optimization
90C32 Fractional programming
90C33 Complementarity and equilibrium problems and variational inequalities (finite dimensions) (aspects of mathematical programming)
90C34 Semi-infinite programming
90C35 Programming involving graphs or networks [See also 90C27]
90C39 Dynamic programming [See also 49L20]
90C40 Markov and semi-Markov decision processes
90C46 Optimality conditions and duality in mathematical programming [See also 49N15]
90C47 Minimax problems in mathematical programming [See also 49K35]
90C48 Programming in abstract spaces
90C49 Extreme-point and pivoting methods
90C51 Interior-point methods
90C52 Methods of reduced gradient type
90C53 Methods of quasi-Newton type
90C55 Methods of successive quadratic programming type
90C56 Derivative-free methods and methods using generalized derivatives [See also 49J52]

90C57 Polyhedral combinatorics, branch-and-bound, branch-and-cut

90C59 Approximation methods and heuristics in mathematical programming

90C60 Abstract computational complexity for mathematical programming problems [See also 68Q25]

90C70 Fuzzy and other nonstochastic uncertainty mathematical programming

90C90 Applications of mathematical programming

90C99 None of the above, but in this section

91-XX Game theory, economics, finance, and other social and behavioral sciences

91-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to game theory, economics, and finance

91-01 exposition (textbooks, tutorial papers, etc.) pertaining to game theory, economics, and finance

91-02 Research exposition (monographs, survey articles) pertaining to game theory, economics, and finance

91-03 History of game theory, economics, and finance [Consider also classification numbers pertaining to Section 01]

91-04 Software, source code, etc. for problems pertaining to game theory, economics, and finance

91-05 Experimental work for problems pertaining to game theory, economics, and finance

91-06 Proceedings, conferences, collections, etc. pertaining to game theory, economics, and finance

91-08 Computational methods for problems pertaining to game theory, economics, and finance

91-10 Mathematical modeling or simulation for problems pertaining to game theory, economics, and finance

91-11 Research data for problems pertaining to game theory, economics, and finance

91Axx Game theory

91A05 2-person games

91A06 n-person games, n > 2

91A07 Games with infinitely many players

91A10 Noncooperative games

91A11 Equilibrium refinements

91A12 Cooperative games

91A14 Potential and congestion games

91A15 Stochastic games, stochastic differential games

91A16 Mean field games (aspects of game theory) [See also 35Q89, 49N80]

91A18 Games in extensive form

91A20 Multistage and repeated games
<table>
<thead>
<tr>
<th>91A22</th>
<th>Evolutionary games</th>
</tr>
</thead>
<tbody>
<tr>
<td>91A23</td>
<td>Differential games (aspects of game theory) [See also 49N70]</td>
</tr>
<tr>
<td>91A24</td>
<td>Positional games (pursuit and evasion, etc.) [See also 49N75]</td>
</tr>
<tr>
<td>91A25</td>
<td>Dynamic games</td>
</tr>
<tr>
<td>91A26</td>
<td>Rationality and learning in game theory</td>
</tr>
<tr>
<td>91A27</td>
<td>Games with incomplete information, Bayesian games</td>
</tr>
<tr>
<td>91A28</td>
<td>Signaling and communication in game theory</td>
</tr>
<tr>
<td>91A30</td>
<td>Utility theory for games [See also 91B16]</td>
</tr>
<tr>
<td>91A35</td>
<td>Decision theory for games [See also 62Cxx, 90B50, 91B06]</td>
</tr>
<tr>
<td>91A40</td>
<td>Other game-theoretic models</td>
</tr>
<tr>
<td>91A43</td>
<td>Games involving graphs {For games on graphs, see 05C57}</td>
</tr>
<tr>
<td>91A44</td>
<td>Games involving topology, set theory, or logic</td>
</tr>
<tr>
<td>91A46</td>
<td>Combinatorial games</td>
</tr>
<tr>
<td>91A50</td>
<td>Discrete-time games</td>
</tr>
<tr>
<td>91A55</td>
<td>Games of timing</td>
</tr>
<tr>
<td>91A60</td>
<td>Probabilistic games; gambling [See also 60G40]</td>
</tr>
<tr>
<td>91A65</td>
<td>Hierarchical games (including Stackelberg games)</td>
</tr>
<tr>
<td>91A68</td>
<td>Algorithmic game theory and complexity [See also 68Qxx, 68Wxx]</td>
</tr>
<tr>
<td>91A70</td>
<td>Spaces of games</td>
</tr>
<tr>
<td>91A80</td>
<td>Applications of game theory</td>
</tr>
<tr>
<td>91A81</td>
<td>Quantum games</td>
</tr>
<tr>
<td>91A86</td>
<td>Game theory and fuzziness</td>
</tr>
<tr>
<td>91A90</td>
<td>Experimental studies</td>
</tr>
<tr>
<td>91A99</td>
<td>None of the above, but in this section</td>
</tr>
</tbody>
</table>

91Bxx Mathematical economics {For econometrics, see 62P20}  

<table>
<thead>
<tr>
<th>91B02</th>
<th>Fundamental topics (basic mathematics, methodology; applicable to economics in general)</th>
</tr>
</thead>
<tbody>
<tr>
<td>91B03</td>
<td>Mechanism design theory</td>
</tr>
<tr>
<td>91B05</td>
<td>Risk models (general) {For actuarial and financial risk, see 91Gxx}</td>
</tr>
<tr>
<td>91B06</td>
<td>Decision theory [See also 62Cxx, 90B50, 91A35]</td>
</tr>
<tr>
<td>91B08</td>
<td>Individual preferences</td>
</tr>
<tr>
<td>91B10</td>
<td>Group preferences</td>
</tr>
<tr>
<td>91B12</td>
<td>Voting theory</td>
</tr>
<tr>
<td>91B14</td>
<td>Social choice</td>
</tr>
</tbody>
</table>
91B15 Welfare economics
91B16 Utility theory [See also 91A30]
91B18 Public goods
91B24 Microeconomic theory (price theory and economic markets)
91B26 Auctions, bargaining, bidding and selling, and other market models
91B32 Resource and cost allocation (including fair division, apportionment, etc.)
91B38 Production theory, theory of the firm
91B39 Labor markets
91B41 Contract theory (moral hazard, adverse selection)
91B42 Consumer behavior, demand theory
91B43 Principal-agent models
91B44 Economics of information
91B50 General equilibrium theory
91B51 Dynamic stochastic general equilibrium theory
91B52 Special types of economic equilibria
91B54 Special types of economic markets (including Cournot, Bertrand)
91B55 Economic dynamics
91B60 Trade models
91B62 Economic growth models
91B64 Macroeconomic theory (monetary models, models of taxation)
91B66 Multisectoral models in economics
91B68 Matching models
91B69 Heterogeneous agent models
91B70 Stochastic models in economics
91B72 Spatial models in economics [See also 91D25]
91B74 Economic models of real-world systems (e.g., electricity markets, etc.)
91B76 Environmental economics (natural resource models, harvesting, pollution, etc.)
91B80 Applications of statistical and quantum mechanics to economics (econophysics)
91B82 Statistical methods; economic indices and measures [See also 62P20]
91B84 Economic time series analysis {For statistical theory of time series, see 62M10}
91B86 Mathematical economics and fuzziness
91B99 None of the above, but in this section
91Cxx Social and behavioral sciences: general topics {For statistics, see 62P25}
91C05 Measurement theory in the social and behavioral sciences
91C15 One- and multidimensional scaling in the social and behavioral sciences
91C20 Clustering in the social and behavioral sciences [See also 62H30]
91C99 None of the above, but in this section

91Dxx Mathematical sociology (including anthropology)
91D10 Models of societies, social and urban evolution
91D15 Social learning
91D20 Mathematical geography and demography
91D25 Spatial models in sociology [See also 91B72]
91D30 Social networks; opinion dynamics
91D35 Manpower systems in sociology [See also 90B70, 91B39]
91D99 None of the above, but in this section

91Exx Mathematical psychology {For psychometrics, see 62P15}
91E10 Cognitive psychology
91E30 Psychophysics and psychophysiology; perception
91E40 Memory and learning in psychology [See also 68T05]
91E45 Measurement and performance in psychology
91E99 None of the above, but in this section

91Fxx Other social and behavioral sciences (mathematical treatment)
91F10 History, political science
91F20 Linguistics [See also 03B65, 68T50]
91F99 None of the above, but in this section

91Gxx Actuarial science and mathematical finance {For statistics, see 62P05}
91G05 Actuarial mathematics
91G10 Portfolio theory
91G15 Financial markets
91G20 Derivative securities (option pricing, hedging, etc.)
91G30 Interest rates, asset pricing, etc. (stochastic models)
91G40 Credit risk
91G45 Financial networks (including contagion, systemic risk, regulation)
91G50 Corporate finance (dividends, real options, etc.)
91G60 Numerical methods (including Monte Carlo methods)
91G70 Statistical methods; risk measures [See also 62P05, 62P20]
91G80 Financial applications of other theories [See also 35Q91, 37N40, 49N90, 60J70, 60K10, 60H30, 93E20]
91G99 None of the above, but in this section

92-XX Biology and other natural sciences

92-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to biology
92-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to biology
92-02 Research exposition (monographs, survey articles) pertaining to biology
92-03 History of biology [Consider also classification numbers pertaining to Section 01]
92-04 Software, source code, etc. for problems pertaining to biology
92-05 Experimental work for problems pertaining to biology
92-06 Proceedings, conferences, collections, etc. pertaining to biology
92-08 Computational methods for problems pertaining to biology
92-10 Mathematical modeling or simulation for problems pertaining to biology
92-11 Research data for problems pertaining to biology

92Bxx Mathematical biology in general
92B05 General biology and biomathematics
92B10 Taxonomy, cladistics, statistics in mathematical biology
92B15 General biostatistics [See also 62P10]
92B20 Neural networks for/in biological studies, artificial life and related topics [See also 68T05, 82C32, 94Cxx]
92B25 Biological rhythms and synchronization
92B99 None of the above, but in this section

92Cxx Physiological, cellular and medical topics
92C05 Biophysics
92C10 Biomechanics [See also 74L15]
92C15 Developmental biology, pattern formation
92C17 Cell movement (chemotaxis, etc.)
92C20 Neural biology
92C30 Physiology (general)
92C32 Pathology, pathophysiology
92C35 Physiological flow [See also 76Z05]
92C37 Cell biology
92C40 Biochemistry, molecular biology
92C42 Systems biology, networks
92C45 Kinetics in biochemical problems (pharmacokinetics, enzyme kinetics, etc.) [See also 80A30]
92C47 Biosensors (not for medical applications)
92C50 Medical applications (general)
92C55 Biomedical imaging and signal processing [See also 44A12, 65R10, 94A08, 94A12]
92C60 Medical epidemiology {For theoretical aspects, see 92D30}
92C70 Microbiology
92C75 Biotechnology
92C80 Plant biology
92C99 None of the above, but in this section

92Dxx Genetics and population dynamics
92D10 Genetics and epigenetics {For genetic algebras, see 17D92}
92D15 Problems related to evolution
92D20 Protein sequences, DNA sequences
92D25 Population dynamics (general)
92D30 Epidemiology {For medical applications, see 92C60}
92D40 Ecology
92D45 Pest management
92D50 Animal behavior
92D99 None of the above, but in this section

92Exx Chemistry {For biochemistry, see 92C40}
92E10 Molecular structure (graph-theoretic methods, methods of differential topology, etc.)
92E20 Classical flows, reactions, etc. in chemistry [See also 80A30, 80A32]
92E99 None of the above, but in this section

92Fxx Other natural sciences (mathematical treatment)
92F05 Other natural sciences (mathematical treatment)
92F99 None of the above, but in this section
93-XX Systems theory; control {For optimal control, see 49-XX}

93-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to systems and control theory

93-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to systems and control theory

93-02 Research exposition (monographs, survey articles) pertaining to systems and control theory

93-03 History of systems and control theory [Consider also classification numbers pertaining to Section 01]

93-04 Software, source code, etc. for problems pertaining to systems and control theory

93-05 Experimental work for problems pertaining to systems and control theory

93-06 Proceedings, conferences, collections, etc. pertaining to systems and control theory

93-08 Computational methods for problems pertaining to systems and control theory

93-10 Mathematical modeling or simulation for problems pertaining to systems and control theory

93-11 Research data for problems pertaining to systems and control theory

93Axx General systems theory

93A05 Axiomatic systems theory

93A10 General systems

93A13 Hierarchical systems

93A14 Decentralized systems

93A15 Large-scale systems

93A16 Multi-agent systems

93A99 None of the above, but in this section

93Bxx Controllability, observability, and system structure

93B03 Attainable sets, reachability

93B05 Controllability

93B07 Observability

93B10 Canonical structure

93B11 System structure simplification

93B12 Variable structure systems

93B15 Realizations from input-output data

93B17 Transformations

93B18 Linearizations

93B20 Minimal systems representations

93B24 Topological methods

93B25 Algebraic methods

215
93B27 Geometric methods
93B28 Operator-theoretic methods [See also 47A48, 47A57, 47B35, 47N70]
93B30 System identification
93B35 Sensitivity (robustness)
93B36 $H^\infty$-control
93B45 Model predictive control
93B47 Iterative learning control
93B50 Synthesis problems
93B51 Design techniques (robust design, computer-aided design, etc.)
93B52 Feedback control
93B53 Observers
93B55 Pole and zero placement problems
93B60 Eigenvalue problems
93B70 Networked control
93B99 None of the above, but in this section

93Cxx Model systems in control theory
93C05 Linear systems in control theory
93C10 Nonlinear systems in control theory
93C15 Control/observation systems governed by ordinary differential equations [See also 34H05]
93C20 Control/observation systems governed by partial differential equations
93C23 Control/observation systems governed by functional-differential equations [See also 34K35]
93C25 Control/observation systems in abstract spaces
93C27 Impulsive control/observation systems
93C28 Positive control/observation systems
93C29 Boolean control/observation systems
93C30 Control/observation systems governed by functional relations other than differential equations (such as hybrid and switching systems)
93C35 Multivariable systems, multidimensional control systems
93C40 Adaptive control/observation systems
93C41 Control/observation systems with incomplete information
93C42 Fuzzy control/observation systems
93C50 Delay control/observation systems
93C55 Discrete-time control/observation systems
93C57 Sampled-data control/observation systems
93C62 Digital control/observation systems
93C65 Discrete event control/observation systems
93C70 Time-scale analysis and singular perturbations in control/observation systems
93C73 Perturbations in control/observation systems
93C80 Frequency-response methods in control theory
93C83 Control/observation systems involving computers (process control, etc.)
93C85 Automated systems (robots, etc.) in control theory [See also 68T40, 70B15, 70Q05]
93C95 Application models in control theory
93C99 None of the above, but in this section

93Dxx Stability of control systems
93D05 Lyapunov and other classical stabilities (Lagrange, Poisson, \(L^p, l^p\), etc.) in control theory
93D09 Robust stability
93D10 Popov-type stability of feedback systems
93D15 Stabilization of systems by feedback
93D20 Asymptotic stability in control theory
93D21 Adaptive or robust stabilization
93D22 Exponential stability
93D25 Input-output approaches in control theory
93D30 Lyapunov and storage functions
93D40 Finite-time stability
93D50 Consensus
93D99 None of the above, but in this section

93Exx Stochastic systems and control
93E03 Stochastic systems in control theory (general)
93E10 Estimation and detection in stochastic control theory [See also 60G35]
93E11 Filtering in stochastic control theory [See also 60G35]
93E12 Identification in stochastic control theory
93E14 Data smoothing in stochastic control theory
93E15 Stochastic stability in control theory
93E20 Optimal stochastic control [See also 49J55, 49K45]
93E24 Least squares and related methods for stochastic control systems
93E35 Stochastic learning and adaptive control
93E99 None of the above, but in this section
94-XX Information and communication theory, circuits

94-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to information and communication theory

94-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to information and communication theory

94-02 Research exposition (monographs, survey articles) pertaining to information and communication theory

94-03 History of information and communication theory [Consider also classification numbers pertaining to Section 01]

94-04 Software, source code, etc. for problems pertaining to information and communication theory

94-05 Experimental work for problems pertaining to information and communication theory

94-06 Proceedings, conferences, collections, etc. pertaining to information and communication theory

94-08 Computational methods for problems pertaining to information and communication theory

94-10 Mathematical modeling or simulation for problems pertaining to information and communication theory

94-11 Research data for problems pertaining to information and communication theory

94Axx Communication, information

94A05 Communication theory [See also 60G35, 90B18]

94A08 Image processing (compression, reconstruction, etc.) in information and communication theory [See also 68U10]

94A11 Application of orthogonal and other special functions

94A12 Signal theory (characterization, reconstruction, filtering, etc.)

94A13 Detection theory in information and communication theory

94A14 Modulation and demodulation in information and communication theory

94A15 Information theory (general) [See also 62B10, 81P45]

94A16 Informational aspects of data analysis and big data [See also 62R07, 68T09] {For homological aspects, see 55N31}

94A17 Measures of information, entropy

94A20 Sampling theory in information and communication theory

94A24 Coding theorems (Shannon theory)

94A29 Source coding [See also 68P30]

94A34 Rate-distortion theory in information and communication theory

94A40 Channel models (including quantum) in information and communication theory [See also 81P47]

94A45 Prefix, length-variable, comma-free codes [See also 20M35, 68Q45]

94A50 Theory of questionnaires

94A55 Shift register sequences and sequences over finite alphabets in information and communication theory

94A60 Cryptography [See also 11T71, 14G50, 68P25, 81P94]

94A62 Authentication, digital signatures and secret sharing [See also 81P94]

94A99 None of the above, but in this section
94Bxx Theory of error-correcting codes and error-detecting codes
94B05 Linear codes, general
94B10 Convolutional codes
94B12 Combined modulation schemes (including trellis codes) in coding theory
94B15 Cyclic codes
94B20 Burst-correcting codes
94B25 Combinatorial codes
94B27 Geometric methods (including applications of algebraic geometry) applied to coding theory [See also 11T71, 14G50]
94B30 Majority codes
94B35 Decoding
94B40 Arithmetic codes [See also 11T71, 14G50]
94B50 Synchronization error-correcting codes
94B60 Other types of codes
94B65 Bounds on codes
94B70 Error probability in coding theory
94B75 Applications of the theory of convex sets and geometry of numbers (covering radius, etc.) to coding theory [See also 11H31, 11H71]
94B99 None of the above, but in this section

94Cxx Circuits, networks [See also 68Q06]
94C05 Analytic circuit theory
94C11 Switching theory, applications of Boolean algebras to circuits and networks
94C12 Fault detection; testing in circuits and networks
94C15 Applications of graph theory to circuits and networks [See also 05Cxx, 68R10]
94C30 Applications of design theory to circuits and networks [See also 05Bxx]
94C60 Circuits in qualitative investigation and simulation of models
94C99 None of the above, but in this section

94Dxx Miscellaneous topics in information and communication theory
94D05 Fuzzy sets and logic (in connection with information, communication, or circuits theory) [See also 03B52, 03E72, 28E10]
94D10 Boolean functions [See also 06E30] {For connections with circuits and networks, see 94C11}
94D99 None of the above, but in this section
97-XX Mathematics education

97-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to mathematics education
97-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mathematics education
97-02 Research exposition (monographs, survey articles) pertaining to mathematics education
97-03 History of mathematics education [Consider also classification numbers pertaining to Section 01]
97-06 Proceedings, conferences, collections, etc. pertaining to mathematics education
97-11 Research data for problems pertaining to mathematics education

97Axx History and society (aspects of mathematics education)

97A30 History in mathematics education {For mathematics history, see 01-XX; for biographies, see 01A70; for history of mathematics education, see 97-03}
97A40 Mathematics education and society {For sociology (and profession) of mathematics, see 01A80}
97A99 None of the above, but in this section

97Bxx Educational policy and systems

97B10 Mathematics educational research and planning
97B20 Educational policy for general education
97B30 Educational policy for vocational education
97B40 Educational policy for higher education
97B50 Mathematics teacher education
97B60 Educational policy for adult and further education
97B70 Syllabuses, educational standards
97B99 None of the above, but in this section

97Cxx Psychology of mathematics education, research in mathematics education

97C10 Comprehensive works on psychology of mathematics education
97C20 Affective behavior and mathematics education
97C30 Cognitive processes, learning theories (aspects of mathematics education)
97C40 Intelligence and aptitudes (aspects of mathematics education)
97C50 Language and verbal communities (aspects of mathematics education)
97C60 Sociological aspects of learning (aspects of mathematics education)
97C70 Teaching-learning processes in mathematics education
97C99 None of the above, but in this section
97Dxx Education and instruction in mathematics
97D10 Comprehensive works and comparative studies on education and instruction in mathematics
97D20 Philosophical and theoretical contributions (maths didactics)
97D30 Objectives and goals of mathematics teaching
97D40 Mathematics teaching methods and classroom techniques
97D50 Teaching mathematical problem solving and heuristic strategies
97D60 Student assessment, achievement control and rating (aspects of mathematics education)
97D70 Learning difficulties and student errors (aspects of mathematics education)
97D80 Mathematics teaching units and draft lessons
97D99 None of the above, but in this section

97Exx Education of foundations of mathematics
97E10 Comprehensive works on education of foundations of mathematics
97E20 Philosophy and mathematics (educational aspects)
97E30 Logic (educational aspects)
97E40 Language of mathematics (educational aspects)
97E50 Reasoning and proving in the mathematics classroom
97E60 Sets, relations, set theory (educational aspects)
97E99 None of the above, but in this section

97Fxx Education of arithmetic and number theory
97F10 Comprehensive works on education of arithmetic and number theory
97F20 Pre-numerical stage, concept of numbers
97F30 Natural numbers (educational aspects)
97F40 Integers, rational numbers (educational aspects)
97F50 Real numbers, complex numbers (educational aspects)
97F60 Number theory (educational aspects)
97F70 Measures and units (educational aspects)
97F80 Ratio and proportion, percentages (educational aspects)
97F90 Real life mathematics, practical arithmetic (educational aspects)
97F99 None of the above, but in this section
97Gxx Geometry education
97G10 Comprehensive works on geometry education
97G20 Informal geometry (educational aspects)
97G30 Area and volume (educational aspects)
97G40 Plane and solid geometry (educational aspects)
97G50 Transformation geometry (educational aspects)
97G60 Plane and spherical trigonometry (educational aspects)
97G70 Analytic geometry, vector algebra (educational aspects)
97G80 Descriptive geometry (educational aspects)
97G99 None of the above, but in this section

97Hxx Algebra education
97H10 Comprehensive works on algebra education
97H20 Elementary algebra (educational aspects)
97H30 Equations and inequalities (educational aspects)
97H40 Groups, rings, fields (educational aspects)
97H50 Ordered algebraic structures (educational aspects)
97H60 Linear algebra (educational aspects)
97H99 None of the above, but in this section

97Ixx Analysis education
97I10 Comprehensive works on analysis education
97I20 Mappings and functions (educational aspects)
97I30 Sequences and series (educational aspects)
97I40 Differential calculus (educational aspects)
97I50 Integral calculus (educational aspects)
97I60 Functions of several variables (educational aspects)
97I70 Functional equations (educational aspects)
97I80 Complex analysis (educational aspects)
97I99 None of the above, but in this section
97Kxx Education of combinatorics, graph theory, probability theory, and statistics
97K10 Comprehensive works on combinatorics, graph theory, and probability (educational aspects)
97K20 Combinatorics (educational aspects)
97K30 Graph theory (educational aspects)
97K40 Descriptive statistics (educational aspects)
97K50 Probability theory (educational aspects)
97K60 Distributions and stochastic processes (educational aspects)
97K70 Foundations and methodology of statistics (educational aspects)
97K80 Applied statistics (educational aspects)
97K99 None of the above, but in this section

97Mxx Education of mathematical modeling and applications of mathematics
97M10 Modeling and interdisciplinarity (aspects of mathematics education)
97M20 Mathematics in vocational training and career education
97M30 Financial and insurance mathematics (aspects of mathematics education)
97M40 Operations research, economics (aspects of mathematics education)
97M50 Physics, astronomy, technology, engineering (aspects of mathematics education)
97M60 Biology, chemistry, medicine (aspects of mathematics education)
97M70 Behavioral and social sciences (aspects of mathematics education)
97M80 Arts, music, language, architecture (aspects of mathematics education)
97M99 None of the above, but in this section

97Nxx Education of numerical mathematics
97N10 Comprehensive works education of numerical mathematics
97N20 Rounding, estimation, theory of errors (educational aspects)
97N30 Numerical algebra (educational aspects)
97N40 Numerical analysis (educational aspects)
97N50 Interpolation and approximation (educational aspects)
97N60 Mathematical programming (educational aspects)
97N70 Discrete mathematics (educational aspects)
97N80 Mathematical software, computer programs (educational aspects)
97N99 None of the above, but in this section
97Pxx Computer science (educational aspects)

97P10 Comprehensive works on computer science (educational aspects)

97P20 Theoretical computer science (educational aspects)

97P30 Systems, databases (educational aspects)

97P40 Programming languages (educational aspects)

97P50 Programming techniques (educational aspects)

97P80 Artificial intelligence (educational aspects)

97P99 None of the above, but in this section

97Uxx Educational material and media and educational technology in mathematics education

97U10 Comprehensive works on educational material and media and educational technology in mathematics education

97U20 Textbooks, textbook research (aspects of mathematics education)

97U30 Teachers' manuals and planning aids (aspects of mathematics education)

97U40 Problem books, competitions, examinations (aspects of mathematics education)

97U50 Computer-assisted instruction, e-learning (aspects of mathematics education)

97U60 Manipulative materials (aspects of mathematics education)

97U70 Technological tools, calculators (aspects of mathematics education)

97U80 Audiovisual media (aspects of mathematics education)

97U99 None of the above, but in this section