# Pacific 

## Journal of

 Mathematics
## VOLUME LXXVI <br> 1978

# PACIFIC JOURNAL OF MATHEMATICS 

## EDITORS

Richard Arens (Managing Editor)
University of California
Los Angeles, California 90024
C. W. Curtis

University of Oregon
Eugene, OR 97403
C. C. Moore

University of California
Berkeley, CA 94720
J. Dugundji

Department of Mathematics University of Southern Californıa Los Angeles, California 90007
R. Finn and J. Milgram

Stanford University
Stanford, California 94305

## ASSOCIATE EDITORS

E. F. Beckenbach B. H. Neumann F. Wolf K. Yoshida

## SUPPORTING INSTITUTIONS

UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY UNIVERSITY OF CALIFORNIA MONTANA STATE UNIVERSITY UNIVERSITY OF NEVADA, RENO NEW MEXICO STATE UNIVERSITY OREGON STATE UNIVERSITY UNIVERSITY OF OREGON

UNIVERSITY OF SOUTHERN CALIFORNIA STANFORD UNIVERSITY UNIVERSITY OF HAWAII UNIVERSITY OF TOKYO UNIVERSITY OF UTAH WASHINGTON STATE UNIVERSITY UNIVERSITY OF WASHINGTON

## CONTENTS

S. Alexander, Local and global convexity in complete Riemannian mänifolds ..... 283
A. N. Al-Hussaini, Potential operators and equimeasurability ..... 1
C. Alsina, On countable products and algebraic convexifications of probabilistic metric spaces ..... 291
T. Anderson and E. Kleinfeld, Semisimple nil algebras of type $\delta$. ..... 9
J. Berman and G. Grätzer, Uniform representations of congruence schemes ..... 301
S. L. Campbell, Linear operators for which $T^{*} T$ and $T+T^{*}$ commute III ..... 17
A. K. Chilana and K. A. Ross, Spectral synthesis in hypergroups ..... 313
D. M. Cohen and H. L. Resnikoff, Hermitian quadratic forms and Hermitian modular forms ..... 329
R. J. Daverman, Special approximations to embeddings of codimension one spheres ..... 21
D. M. Davis, Connective coverings of $B O$ and immersions of projective spaces ..... 33
F. R. DeMeyer, Metabelian groups with an irreducible projective representation of large degree ..... 339
R. Ellis, The Furstenberg structure theorem ..... 345
H. W. Engl, Randon fixed point theorems for multivalued mappings ..... 351
W. A. Ettling, On arc length sharpenings ..... 361
K. R. Fuller and J. Haack, Rings with quivers that are trees ..... 371
K. R. Goodearl, Centers of regular self-injective rings ..... 381
G. Grätzer, See J. Berman and G. Grätzer
J. Gregory, Numerical algorithms for oscillation vectors ofsecond order differential equations including the Euler-Lagrange equation for symmetric tridiagonal matrices . 397
B. Grünbaum and G. C. Shephard, Isotoxal tilings ..... 407
J. Haack, See K. R. Fuller and J. Haack
V. L. Hansen, The homotopy type of the space of maps of a homology 3-sphere into the 2-sphere ..... 43
M. S. Henry and K. Wiggins, Applications of approximation theory to differential equations with deviating arguments. ..... 431
J. V. Herod, A product integral representation for the generalized inverse of closed operators ..... 51
A. A. Iskander, Definability in the lattice of ring varieties ..... 61
R. A. Johnson, Existence of a strong lifting commuting with a compact group of transformations ..... 69
M. Jungerman, The non-orientable genus of the $n$-cube ..... 443
H. J. K. Junnila, Neighbornets ..... 83
K. G. Kalb, On the expansion in joint generalized eigenvectors. ..... 109
R. R. Kallman, Only trivial Borel measures on $S_{\infty}$ are quasi- invariant under automorphisms ..... 453
E. Kleinfeld, See T. Anderson and E. Kleinfeld
J. Longman and M. Rich, Scalar dependent algebras in the alternative sense ..... 463
F. J. Martinelli, Construction of generalized normal numbers ..... 117
R. Mollin, The Schur group of a field of characteristic zero ..... 471
E. J. O'Neill, On Massey products ..... 123
V. Paulsen, Continuous canonical forms for matrices under unitary equivalence ..... 129
J. Peters and T. Sund, Automorphisms of locally compact groups ..... 143
D. Pokrass, Some radical properties of rings with $(a, b, c)=$ ( $c, a, c$ ) ..... 479
D. Randall, Tangent frame fields on spin manifolds ..... 157
J. B. Remmel, Realizing partial ordering by classes of co-simple sets ..... 169
H. L. Resnikoff, See D. M. Cohen and H. L. ResnikoffM. Rich, See J. Longman and M. Rich
K. A. Ross, See A. K. Chilana and K. A. Ross
J. H. Rubinstein, One-sided Heegaard splittings of 3-manifolds . 185
D. C. Rung, Meier type theorems for general boundary approach and $\sigma$-porous exceptional sets ..... 201
T. Sand, See J. Peters and T. Sand
S. Sato, Positive operators and the ergodic theorem ..... 215
I. H. Shavel, A class of algebraic surfaces of general type constructed from quaternion algebras ..... 221
M. Shay and P. Young, Characterizing the orders changed by program translators ..... 485
G. C. Shephard, See B. Grünbaum and G. C. Shephard
J. Siegel, On the structure of $B_{\infty}(F), F$ a stable space ..... 491
S. Singh, (hnp)-rings over which every module admits a basic submodule ..... 509
P. F. Smith, Decomposing modules into projectives and injectives ..... 247
A. K. Snyder, Universal interpolating sets and the Nevanlinna- Pick property in Banach spaces of functions ..... 513
J. D. Vaaler, On the metric theory of diophantine approximation ..... 527
R. Ware, When are Witt rings group rings? II ..... 541
K. Wiggins, See M. S. Henry and K. Wiggins
P. Young, See M. Shay and P. Young
S. E. Zarantonello, The sheaf of outer functions in the polydisc ..... 267

## Pacific <br> Journal of Mathematics

A. N. Al-Hussaini, Potential operators and equimeasurability ..... 1
T. Anderson and E. Kleinfeld, Semisimple nil algebras of type $\delta$ ..... 9
S. L. Campbell, Linear operators for which $T^{*} T$ and $T+T^{*}$ commute III ..... 17
R. J. Daverman, Special approximations to embeddings of codimension one spheres ..... 21
D. M. Davis, Connective coverings of BO and immersions of projective spaces ..... 33
V. L. Hansen, The homotopy type of the space of maps of a homology 3-sphere into the 2 -sphere ..... 43
J. V. Herod, A product integral representation for the generalized inverse of closed operators ..... 51
A. A. Iskander, Definability in the lattice of ring varieties ..... 61
R. A. Johnson, Existence of a strong lifting commuting with a compact group of transformations ..... 69
H. J. K. Junnila, Neighbornets ..... 83
K. G. Kalb, On the expansion in joint generalized eigenvectors ..... 109
F. J. Martinelli, Construction of generalized normal numbers ..... 117
E. J. O'Neill, On Massey products ..... 123
V. Paulsen, Continuous canonical forms for matrices under unitary equivalence ..... 129
J. Peters and T. Sund, Automorphisms of locally compact groups ..... 143
D. Randall, Tangent frame fields on spin manifolds ..... 157
J. B. Remmel, Realizing partial orderings by classes of co-simple sets ..... 169
J. H. Rubinstein, One-sided Heegaard splittings of 3-manifolds ..... 185
D. C. Rung, Meier type theorems for general boundary approach and $\sigma$-porous exceptional sets ..... 201
R. Sato, Positive operators and the ergodic theorem ..... 215
I. H. Shavel, A class of algebraic surfaces of general type constructed from quaternion algebras ..... 221
P. F. Smith, Decomposing modules into projectives and injectives ..... 247
S. E. Zarantonello, The sheaf of outer functions in the polydisc ..... 267

# PACIFIC JOURNAL OF MATHEMATICS 

## EDITORS

Richard Arens (Managing Editor)<br>University of California<br>Los Angeles, CA 90024<br>Charles W. Curtis<br>University of Oregon<br>Eugene, OR 97403<br>C. C. Moore<br>University of California<br>Berkeley, CA 94720

J. Dugundji<br>Department of Mathematics<br>University of Southern California<br>Los Angeles, CA 90007<br>R. Finn and J. Milgram<br>Stanford University<br>Stanford, CA 94305

## ASSOCIATE EDITORS

E. F. Beckenbach<br>B. H. Neumann<br>F. Wolf<br>K. Yoshida

## SUPPORTING INSTITUTIONS

UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY UNIVERSITY OF CALIFORNIA MONTANA STATE UNIVERSITY UNIVERSITY OF NEVADA, RENO NEW MEXICO STATE UNIVERSITY OREGON STATE UNIVERSITY UNIVERSITY OF OREGON

UNIVERSITY OF SOUTHERN CALIFORNIA STANFORD UNIVERSITY UNIVERSITY OF HAWAII
UNIVERSITY OF TOKYO
UNIVERSITY OF UTAH WASHINGTON STATE UNIVERSITY UNIVERSITY OF WASHINGTON

The Supporting Institutions listed above contribute to the cost of publication of this Journal, but they are not owners or publishers and have no responsibility for its content or policies.

Mathematical papers intended for publication in the Pacific Journal of Mathematics should be in typed form or offset-reproduced, (not dittoed), double spaced with large margins. Please do not use built up fractions in the text of the manuscript. However, you may use them in the displayed equations. Underline Greek letters in red, German in green, and script in blue. The first paragraph or two must be capable of being used separately as a synopsis of the entire paper. Items of the bibliography should not be cited there unless absolutely necessary, in which case they must be identified by author and journal, rather than by item number. Manuscripts, in triplicate, may be sent to any one of the editors. Please classify according to the scheme of Math. Reviews, Index to Vol. 39. All other communications should be addressed to the managing editor, or Elaine Barth, University of California, Los Angeles, California, 90024.

50 reprints to each author are provided free for each article, only if page charges have been substantially paid. Additional copies may be obtained at cost in multiples of 50 .

The Pacific Journal of Mathematics is issued monthly as of January 1966. Regular subscription rate: $\$ 72.00$ a year ( 6 Vols., 12 issues). Special rate: $\$ 36.00$ a year to individual members of supporting institutions.

Subscriptions, orders for numbers issued in the last three calendar years, and changes of address should be sent to Pacific Journal of Mathematics, 103 Highland Boulevard, Berkeley, California, 94708. Older back numbers obtainable from Kraus Periodicals Co., Route 100, Millwood, NY 10546.

[^0]
[^0]:    PUBLISHED BY PACIFIC JOURNAL OF MATHEMATICS, A NON-PROFIT CORPORATION
    Printed at Kokusai Bunken Insatsusha (International Academic Printing Co., Ltd.). 8-8, 3-chome, Takadanobaba, Shinjuku-ku, Tokyo 160, Japan.

