MAY MEETING OF THE ROCKY MOUNTAIN SECTION

The forty-sixth annual meeting of the Rocky Mountain Section of the Mathematical Association of America was held at Brigham Young University, Provo, Utah on Friday and Saturday, May 3 and 4, 1963. Professor M. L. Madison, Governor, and Professor H. J. Fletcher, Chairman, presided. There were 109 persons registered.

The following officers were elected for 1963–64: Chairman, Professor J. S. Leech, Colorado College; Vice-Chairman, Professor I. L. Hebel, Colorado School of Mines; and Secretary-Treasurer, Professor Leota C. Hayward, Colorado State University, Professor E. R. Deal, Colorado State University, was appointed coordinator of High School Mathematics Contests for a three year term.

By-Laws for the section as prepared by Professors F. M. Carpenter and I. L. Hebel were unanimously approved.

The 1964 spring meeting will be held at Colorado College, Colorado Springs, Colorado.

The Friday evening guest speaker was Professor B. W. Volkmann, visiting professor at the University of Utah, who spoke on *Transcendental numbers and their approximation properties*.

The following papers were presented:

1. *Singular families of Sturm-Liouville systems*, by Professor F. M. Stein, Colorado State University.

The following theorem is proved: The only singular Sturm-Liouville systems that generate families of Sturm-Liouville systems are those of Hermite, Jacobi, and Laguerre.

2. *The digital computer in secondary school education*, by R. L. Albrecht, Control Data Corporation.

A program of computer education for secondary school students has been established in Denver and Jefferson Counties, Colorado. More than 200 students are enrolled. In this program, emphasis is placed on the development of precise mathematical problem-solving procedures, the computer is regarded as a tool for the solution of mathematical problems, and auto-instructional teaching methods are used. Textbooks are being developed for teaching computer methods in secondary schools. These books are related to the texts of the School Mathematics Study Group and the University of Illinois Committee on School Mathematics.

3. *Some stochastic arithmetic series*, by Professor E. A. Power, visiting professor, University of Colorado.

Some arithmetical series, whose nth terms are sums of inverse products of n integers, are summed. They arise from a model problem involving scalar neutral π-mesons interacting with fixed sources.

4. *Semi-multiplicative functions and correlation functions*, by Professor D. F. Rearick, University of Colorado.

5. *A characterization of separable metric spaces*, by William Eaton, University of Utah.

A chain in a metric space is a collection of open sets which is simply ordered by set inclusion. The following statements are equivalent in a metric space S, (1) S is separable, (2) every chain C in S has a countable subchain C' such that $\bigcup_{A\in C}A=\bigcup_{B\in C'}B$, (3) every chain C in S has a countable subchain C' such that $\bigcap_{A\in C}A=\bigcap_{B\in C'}B$.

6. *Damped motion of a fixed-free uniform beam subjected to an acceleration pulse*, by E. M. Grenning, Thiokol Chemical Corporation.

An analytical solution is presented for the damped motion of a fixed-free uniform beam subjected to a short acceleration pulse at its fixed end. Deflection due to shear is neglected, thus allowing the use of the Euler-Bernoulli beam equations. To obtain the motion during the acceleration pulse, a transformation of the dependent variable is used to transfer the nonhomogeneity from the boundary conditions to the differential equation. The resulting nonhomogeneous partial differential equation is then solved. Motion subsequent to the removal of the acceleration is obtained using initial conditions as derived from the solution for motion during acceleration.

7. *Modified Lommel functions*, by 1st/Lt. C. N. Rollinger, Instructor in Mathematics, U. S. Air Force Academy.

The modified Lommel function is defined as a special case of the Lommel function when the argument of the latter is imaginary. It is shown that the modified function, which is a particular solution of a nonhomogeneous Bessel equation, can be used to evaluate certain integrals.

8. *Testing for integer cases in binary computers*, by Major H. K. Leland, Assistant Professor of Mathematics, U. S. Air Force Academy.

9. *Interlacing properties of characteristic values of Sturm-Liouville systems involving interface boundary conditions*, by Professor L. C. Barrett and G. E. Bendixen, South Dakota School of Mines and Technology.

The primary purpose of this paper is to describe how the characteristic values of a general second order Sturm-Liouville system with interface boundary conditions interlace those of associated Sturm-Liouville systems of a more elementary type. To illustrate the results, a detailed discussion is presented of the problem of a torsionally vibrating shaft, one part of which is tapered with circular cross-sections, the other part being cylindrical. The shaft parameters, such as the modulus of elasticity in shear and the density, need not be the same for both segments.

10. *On the topology of Boolean rings*, by J. C. Higgins, Brigham Young University.

This paper compares topologies for Boolean rings as found in papers by M. H. Stone and P. R. Halmos. Results from these papers are used to characterize rings which have an operator topology homeomorphic to a prime ideal topology. In such rings every ideal is a simple ideal.

11. *Essential fixed points*, by Professor D. L. Schmidt, Colorado State College.

Let X be a compact metric space with the fixed point property. Let X^X be the set of all continuous mappings on X into X, metrized with the supremum norm. P is an essential fixed point of f if corresponding to each neighborhood U of P there is a neighborhood N of f such that if g is in N then g has a fixed point in U. This definition is due to M. K. Fort, Jr. It is shown that results on essential fixed points can be obtained in a compact Hausdorff space X by making use of the fact that the topology on X is uniform.

12. *The range of a Boolean function*, by N. H. Eggert, Utah State University.

13. *Boolean-like algebra*, by E. D. Goodrich, Utah State University.

14. *A modified Maclaurin integral test*, by Professor L. C. Barrett, South Dakota School of Mines and Technology.

In its most elementary form, Maclaurin's integral test is used to examine series such as $\sum_{j=1}^{\infty} f(j)$ for convergence or divergence when the continuous function $f(x)$ ultimately becomes and remains positive and monotone decreasing. This paper provides a modification of the test which may be applied to series of the type $\sum_{j=1}^{\infty} f(\lambda_j)$ when $f(x)$ has the aforesaid properties and λ_j is the jth element of a strictly monotone increasing sequence. Extensions of this test to other kinds of sequences are also considered, together with its use in connection with boundary value problems.

15. *A differential-difference equation describing mixing in certain biological systems*, by Professor H. R. Bailey, Colorado State University.

16. *Approximate solutions of a system of linear differential equations*, by Professor F. M. Stein and Mr. K. F. Klopfenstein, Colorado State University; presented by Mr. Klopfenstein.

Approximation in the sense of least rth powers, $r \geqq 1$, of the solution vector of the system of n first order linear differential equations $\bar{L}\bar{y}(t)=\bar{D}+\bar{F}(t)\bar{y}(t)=\bar{f}(t)$, subject to the nonhomogeneous two-point boundary conditions $\bar{A}\bar{y}(a)+\bar{B}\bar{y}(b)=\bar{h}$ by a vector of polynomials satisfying the end-point conditions is considered. Existence and uniqueness of approximating vectors of polynomials of degree m, $\bar{p}_m(t)$, are discussed, and it is shown that the sequence $\bar{L}\bar{p}(t)$ converges in the mean of order r to the vector function $\bar{f}(t)=\bar{L}\bar{y}(t)$.

17. *Transform methods for difference equations*, by Professor C. A. Grimm and Mr. Wayne Walther, South Dakota School of Mines and Technology; presented by Mr. Walther.

LEOTA C. HAYWARD, *Secretary*

MAY MEETING OF THE WISCONSIN SECTION

The thirty-first annual meeting of the Wisconsin Section of the Mathematical Association of America was held at Carroll College, Waukesha, Wisconsin, on May 4, 1963. Professor G. L. Bullis, Chairman of the Section, presided. This meeting was held jointly with the May meeting of the Wisconsin Mathematics Council and there were 159 present, including 69 members of the Association and 81 members of the Wisconsin Mathematics Council.

At the business meeting the following officers were elected for the coming year: Chairman, Professor C. E. Flanagan, Wisconsin State College, Whitewater; Vice-Chairman, Professor J. M. Osborn, Jr., University of Wisconsin; Secretary-Treasurer, Professor E. F. Wilde, Beloit College.

The following papers were presented:

1. *The concept of precompactness*, by Professor M. B. Smith, Jr., University of Wisconsin.

A subset M of a topological space S is said to be precompact if and only if every infinite subset of M has a limit point in S. This paper discussed the relation between precompactness and some of the definitions of compactness. Examples of topological spaces were discussed in which there exist precompact sets whose closures contain infinite sets having no limit point. It was proved, however, that in a normal T_1 topological space the closure of a precompact set is compact.

2. *Some problems in the geometry of numbers*, by Professor M. N. Bleicher, University of Wisconsin.

This work attempts to indicate some problems and methods of the geometry of numbers. Determining the average number A_k of representations of the first k integers as the sum of two squares of integers is equivalent to determining the number N_k of lattice points (points with integral coordinates) in the circle with radius $\sqrt{k}$ and center (0, 0), since $kA_k=N_k-1$. Also, N_k is asymptotic to πk. Difficult unsolved problems remain in estimating $\pi k-N_k$. From Minkowski's convex body theorem, proved by Blichfeldt's method, it follows that (1) $|ax+by|\cdot|cx+dy| < |ad-bc|$, (2) $|y\alpha-x|<y^{-1}$, (3) $(ax^2+bxy+cy^2)^2<b^2-4ac$, for $b^2-4ac>0$, have infinitely many integral solutions. Analogs of (3) are known for definite forms.

3. *Report of the Pittsburgh meeting of the National Council of Teachers of Mathematics*, by L. C. Dalton, Waukesha Public Schools, Waukesha.

4. *Report on the mathematics scene in Wisconsin*, by A. M. Chandler, State Department of Public Instruction, Madison.

5. *The map color problem on surfaces of higher genus*, by Professor William Gustin, University of Wisconsin.

In 1890 Heawood showed that for any map on a closed surface S_h of positive genus h (with h holes or handles), there is a way of coloring its regions, so that no two adjacent regions be colored