THE APRIL MEETING OF THE IOWA SECTION

The 50th regular meeting of the Iowa Section of the Mathematical Association of America was held at Iowa State University, Ames, on April 19, 1963. Chairman Lyle E. Pursell presided. Total attendance was 96, including 53 members of the Association. Routine business was considered during the afternoon meeting.

A report of the Iowa 1963 high school mathematics contest was given by Lewis Workman of the Des Moines Actuaries Club, who sponsors it.

A treasurer's report was given and a balance of $222.18 was indicated.

The following officers were elected:

Chairman, C. H. Lindahl, Iowa State University, Ames

Vice-Chairman, R. S. Jacobson, Luther College, Decorah

Secretary-Treasurer, Earle L. Canfield, Drake University, Des Moines

Conflicting dates between the Iowa Section spring meeting date and the regional meeting of the American Mathematical Society were again discussed. No specific action to remedy the conflict was taken.

The following papers completed the program:

Friday morning, April 19, 1963, 8:45-10:45

Propagation and growth of waves in hypo-elastic media, by Professor G. A. Nariboli, Iowa State University, introduced by the Chairman.

Using the theory of singular surfaces, wave phenomena in a hypo-elastic medium is discussed. In a medium, arbitrarily stressed initially, the waves, when all three fronts exit, do not separate into divergence-free and vorticity-free modes. For a medium, unstressed and rest, the modes are the same as in linear theory. But, while the growth of shear wave is similar to that in linear theory, a moving dilatational front may terminate into a 'shock', depending on the material constants, irrespective of its being compressive or a rarefaction one. The integration of the growth equation for the most general medium and the detailed study, by method of characteristics, of the generalized one dimensional problem as in gas-dynamics, are under investigation.

An application of covering spaces, by Professor George Seifert, Iowa State University.

Consider an n-cell containing the origin and suppose its boundary S^{n-1} has the following property: every point on S^{n-1} contains a neighborhood in S^{n-1} such that any ray from the origin intersecting this neighborhood intersects it exactly once. Then it is shown by using the concept of a covering space that any ray from the origin intersects S^{n-1} exactly once.

Solutions for diffusion equations with integral type boundary conditions, by Professor K. L. Deckert, Iowa State University and Professor C. G. Maple, Iowa State University, presented by Professor Maple.

Let the standard linear diffusion boundary value problem have one boundary condition replaced by an integral condition of the type $\int_0^1 u(x,t)dx = h(t)$, where u is the solution function and h is a given continuous function. Under suitable conditions, it is shown that there exists a unique solution of this problem. Continuity of the given functions usually associated with this problem is not sufficient for the existence of the solution. But if there exists a continuous function $H(t)$ such that h is the convolution of H with $\theta_3(0,t) - \theta_3(\frac{1}{2},t)$, where θ_3 is the theta function of type 3, then a solution exists.

The cubic equation in a finite field, by Professor Edward S. Allen, Iowa State University.

This paper considers the application of Cardan's method to the solution of a cubic equation in a finite field. Since this method involves the solution of a quadratic equation, it has, for characteristic 2, the limitations described by Beniamino Segre ("Lectures on Modern Geometry", pp. 103-

107). A characteristic of 3 results in difficulties for the cubic equation analogous to those for quadratic equations in a field of characteristic 2. For higher characteristics there are no difficulties except for the possible non-existence of a desired square or cube root. Examples are given with fields of order 8 (characteristic 2) and 5.

The Committee on the Undergraduate Program in Mathematics (CUPM) proposals for pregraduate training in mathematics, by Professor G. Baley Price, University of Kansas. (By invitation).

Friday afternoon, 2:15 - 4:30

The History of the Four-Color Problem, by Professor H. S. M. Coxeter, University of Toronto. (By invitation).

A method of determining a polynomial function with domain an arithmetic progression, by Mr. Robert Buenker, student, Loras College, introduced by the Chairman.

Given a table of ordered pairs with domain an arithmetic progression, it is possible to construct another set of ordered pairs by associating with the given domain a range consisting of the differences between successive ordinates in the original range. It may be proved that the second function must be a polynomial of degree $n - 1$ if the function satisfying the original ordered pairs is a polynomial of degree n. Using this property it is possible to construct the unique polynomial of degree n which satisfies $n + 1$ ordered pairs with domain an arithmetic progression.

An abstract characterization of the trace class of operators, by Rev. John C. Friedell, Loras College.

The trace class is a subset of the Banach Algebra of all bounded linear operators on a Hilbert space and is so called because a natural trace function can be defined on it. This paper defined an abstract trace algebra and proved that every trace algebra is dense in an H*-algebra. Further results obtained are:

(i) a trace algebra is a semi-simple, symmetric annihilator algebra, and (ii) if it is complete in the scalar product norm defined from the trace, it is finite-dimensional.

Image system in an ellipse due to an external source, by Mrs. Matilde Macagno, Iowa Institute for Hydraulic Research, State University of Iowa.

The image system induced inside an ellipse by an external source is obtained by means of conformal mapping and the circle theorem. The corresponding images are found to be located in the first or second sheet of the Riemann surface. For a source located at an arbitrary point in the plane, the image system in the first Riemann sheet consists of a linear distribution of sources and sinks and a distribution of vortices both lying between the foci or/a point source within the ellipse, a distribution of sinks and a distribution of vortices lying both between the foci.

Mathematics in the Iowa State Technical Institute, by Professor Fred Robertson, Iowa State University.

The author listed the topics in algebra, trigonometry and calculus which are taught in the Iowa State Technical Institute. Methods of presenting these topics to attain the mathematical objectives of the general technical institute program were discussed.

An algorithm for the solution of a five point matrix-difference equation, by Professor H. J. Weiss, Iowa State University.

Finite difference approximations are used to transform a system of M fourth-order, ordinary, linear differential equations for M functions f into a system of difference equations

$$(*) \quad \sum_{k=-2}^{2} E_i^{(k)} \bar{x}_{i+k} + \bar{C}_i = 0, \quad i = 1,2,\ldots,N,$$

where $\bar{x}_i$ are (M x 1) vectors whose elements are the unknown function values $f_i^{(j)}$ at the nodal point i; $E_i^{(k)}$ are (M x M) coefficient matrices; and $\bar{C}_i$ are (M x 1) vectors corresponding to inhomogeneous terms in the differential equations. From boundary conditions, the existence of initial recurrence relations

$$\bar{x}_{-1} = P_1 \bar{x}_0 + Q_1 \bar{x}_1 + \bar{q}_1$$

$$\bar{x}_0 = P_2 \bar{x}_1 + Q_2 \bar{x}_2 + \bar{q}_2$$

is demonstrated, where $P_1, \ldots Q_2$ are (M x M), $\bar{q}_1, \bar{q}_2$ are (M x 1). From (*) matrices P_i, Q_i, $\bar{q}_i$ can be calculated for i = 3,4,..., N + 2. The functional vector x is then computed from

$$\bar{x}_i = P_{i+2}\, \bar{x}_{i+1} + Q_{i+2}\, \bar{x}_{i+2} + \bar{q}_{i+2}$$

Calculation of matrices P_i, Q_i, $\bar{q}_i$ involves a sequence of N inversions of (M x M) matrices, whereas a direct solution of (*) essentially involves inversion of an (M N x M N) matrix.