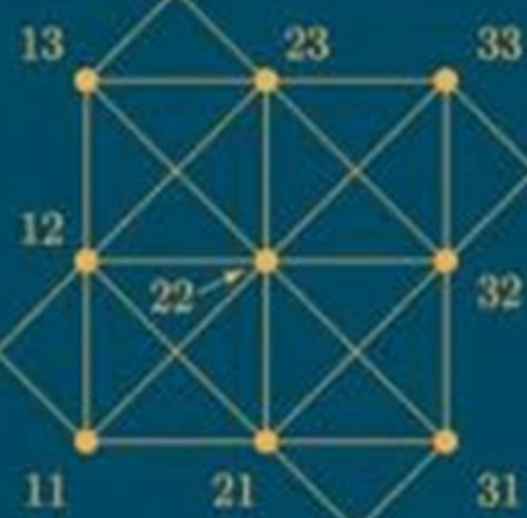


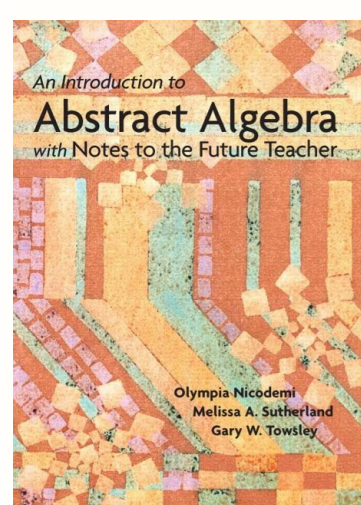
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# INTRODUCTION TO ABSTRACT ALGEBRA



Jonathan D. H. Smith

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## A Review of Methods and Techniques of Teaching Abstract Algebra at BS Level

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### Abstract:

Communicating abstract algebra is a difficult task. Same is the case for the process of learning abstract algebra. The objective of this study is to review the existing B. Sc. (two years) and M. Sc. (two years) programs and the teaching methods for these programs. The system is now replaced by four years BS program. The BS program is different in nature needing a different method for teaching. This study suggests some techniques to improve methods of teaching and communication so that a better understanding of abstract algebra can be developed among the students in this system. It is recommended to adopt computer algebra system (CAS) for a better understanding and involvement other students in the process of learning

### 0. Introduction

The traditional tools for teaching and learning algebra include **text books, lecture notes, lectures, assignments & exams**. The existing tools with their entire shortcoming are commonly used and recognized by the teaching community for teaching Mathematics. In the following we will discuss some aids to enhance the impact of these existing tools so that the same tools can be utilized to develop a better understanding of the subject in the students.

We will proceed further by stressing on the **lectures** only. In our view a **good lecture must be clear, systematic, complete and precise**. However, despite all its qualities a lecture is a **bad teaching instrument if it is dull**. A good lecture contributes to assist the students at all the stages of acquiring knowledge. Thus just lecturing in any manner and demonstrating any material may hardly be of any use to the students. Thus it is essential for any prospective teacher to understand and know that **how students learn Mathematics?** Students learn Mathematics through **intuition, induction, contrast, analogy, simulation and analysis**. All these stages are related to the mental level of the audience. As a first step a good teacher must keep care of the mental level of individual students because every student has a different ability to adopt and understand and it is the duty of the teacher to help the students to overcome their **difficulties**. So a lecture should be planned to cover the needs of all the students in the class.

# Quantum theory of time perception: phases, clocks and quantum algebra

Rukhsan Ul Haq and Shalini Harkar

**Abstract.** Experience of time is one of the primordial human experiences which is deeply tied to human consciousness. But despite this intimate relation of time with human conscious experience, time has proved to be very elusive. Particularly in physics, though there is already some understanding of time, there are still so many paradoxes that plague this understanding. In this paper we take rather a different route to question of time. We first attempt to come up with a theoretical understanding of time perception. Quite interestingly we find that quantum theory provides an algebraic formulation within which we can understand some essential aspects of time perception by human mind. We then ask whether a similar formalism can furnish the understanding of time as well and find connections of our formulation of time with similar works by other researchers. Our underlying approach to question of time has been inspired by R. W. Hamilton who considers algebra as science of pure time. Hence our work has an extensive algebraic flavor. Our work also incorporates another approach based on Kauffman's iterant algebra which relates time to underlying recursions and oscillations. We believe that our work will initiate more investigations in this direction.

**Keywords.** time perception; Bost-Connes system;  $Z_N$  clocks; quantum algebra;

## 1. Introduction

Space and time are integral part of our conscious experience. Our cognition of outside world happens through the mental construction of spatial and temporal structures. They are the two basic varieties of our cognitive apparatus. It is no wonder then that space and time form the most fundamental concepts of any theory of the universe. Space and time have always been studied right from the very beginning of human civilization. Because of the fact that space and time are intimately related to human psyche they not only arise in philosophical and scientific discourses rather they understandably also form

### SPECTRAL MAPPING THEOREM FOR REAL BANACH ALGEBRAS S. B. Kakani and B. V. Limaye

**Introduction.** The spectral mapping theorem states, among other things, that if  $f$  is an analytic function in a neighbourhood of the spectrum  $\text{Sp}_A(a)$  of an element  $a$  of a complex Banach algebra  $A$ , then it is possible to define an element  $\tilde{f}(a)$  in  $A$  whose spectrum is given by  $\text{Sp}_A(\tilde{f}(a)) = \{f(\lambda) : \lambda \in \text{Sp}_A(a)\}$ . A well-known application of this theorem is for the spectral theorem for normal operators on a Hilbert space. In the present paper, we show that this theorem can be extended with all its essential features to the case of a larger class of Banach algebras, namely real Banach algebras. It is well-known that in the case of a real Banach algebra  $A$ , the spectrum  $\text{Sp}_A(a)$  of an element  $a$  in  $A$  is symmetric about the real axis, that is, whenever  $\lambda$  is in  $\text{Sp}_A(a)$ ,  $\bar{\lambda}$  also belongs to  $\text{Sp}_A(a)$ . Hence we have to consider a neighbourhood  $D$  of  $\text{Sp}_A(a)$  which is symmetric about the real axis. Then the spectral mapping theorem holds for all those analytic functions  $f$  in  $D$  which satisfy  $\overline{f(\lambda)} = f(\bar{\lambda})$ ,  $\lambda \in D$ . These functions include polynomials and rational functions with real coefficients. All the proofs in this paper are similar to the corresponding proofs appearing in Sections 6 and 7 of [1]. Moreover, all the proofs are intrinsic, that is, they do not use the complexification technique. (See [2], [3], [4] for similar considerations.)

**1. Preliminaries.** In this section, we study some properties of the spectrum of an element of a real Banach algebra and prove the spectral mapping theorem for rational functions with real coefficients. These results are used in the next section to prove the spectral mapping theorem for analytic functions.

Let  $R$  and  $C$  denote the sets of all real and complex numbers respectively.  
**DEFINITION 1.1.** Let  $A$  be a real algebra. For  $a \in A$ , the spectrum  $\text{Sp}_A(a)$  of  $a$  is defined as follows:

(i) If  $A$  contains a unit element 1, then

$$\text{Sp}_A(a) = \{\lambda \in R : \lambda - a, \lambda - a^2, \lambda^2 - a^2 \text{ is singular in } A\}.$$

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Basic Abstract Algebra 2nd Edition is a comprehensive book for students doing their B.Sc in Mathematics. The book comprises of several examples that are fully worked out, and many problems for practice that, on solving, help students get a better understanding of the subject. It is essential for Math students during their 3rd year. About P. B. Bhattacharya P.B. Bhattacharya is an Indian writer who has helped co-author this book. About S. K. Jain S. K. Jain is an Indian writer who has helped co-author this book. About S. R. Nagpaul S. R. Nagpaul was a visiting professor of Mathematics at the University of Ohio from 1983-1984, and later from 1999-2004. He has co-authored one other book: Linear Algebra. Nagpaul has received his PhD from Harvard University. He used to be the Head of the Department of Mathematics at Stephens College, Delhi. His special interest lies in Discrete Mathematics. This is really a great book for abstract algebra, not only it explains Group theory but also ring theory, and modules and other stuff.. also the book explains the prerequisites of Group theory (set theory and some linear algebra), if you want to self-study abstract algebra it's a pretty great book, just a disclaimer that don't go by the name that includes "Basic", it has lots of advanced stuff too... This book is designed in accordance with the new UGC syllabus for all Indian universities at the undergraduate and advanced honours levels as well as for the first year post-graduate students of many Indian universities. Students appearing for the NET, GATE, SLET or MCA examination will find this book useful too. Moreover, the curriculum requirements of Abstract Algebra offered in engineering courses are also covered in this book. This edition has a complete chapter with worked out examples and exercises on Boolean Algebra. The Chinese remainder theorem and Euler's Phi function has also been discussed in the appendix. Among the salient features of the book are: A rich collection of numerous examples. Visual illustrations wherever necessary. Explanatory notes in the form of footnotes. Some mind-boggling, relevant problems with their latest developments, in the Appendices. Various references to relevant web sites. Glimpses of relevant history of mathematics and mathematicians. Large number of solved exercises. Well-planned and graded exercises with objective and multiple choice questions. Answers (with hints) to large number of exercises. hi, I have mentioned two books name which is best for introductory of abstract algebra, Contemporary abstract algebra - by Joseph A. Gallian Group Theory -by Asha Gauri Shankar Contemporary Abstract Algebra (English, Paperback, Gallian Joseph A.)Hurry, Only 2 left!Buy More Save More Offer Buy 3 items save 5%; Buy 4 save 7%; Buy 5+ save 10%Partner Offer Buy this product and get upto ₹250 off on Flipkart FurnitureFree ₹40 | Delivery by 14 Aug, SundayIf ordered within 30m 46s Something went wrong. Wait a moment and try again.

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