Lecture 1 Department Of Mathematics

?This book is the result of a joint venture between Professor Akio Kawauchi, Osaka City University, well-known for his research in knot theory, and the Osaka study group of mathematics education, founded by Professor Hirokazu Okamori and now chaired by his successor Professor Tomoko Yanagimoto, Osaka Kyoiku University. The seven chapters address the teaching and learning of knot theory from several perspectives. Readers will find an extremely clear and concise introduction to the fundamentals of knot theory, an overview of curricular developments in Japan, and in particular a series of teaching experiments at all levels which not only demonstrate the creativity and the professional expertise of the members of the study group, but also give a lively impression of students' learning processes. In addition the reports show that elementary knot theory is not just a preparation for advanced knot theory but also an excellent means to develop spatial thinking. The book can be highly recommended for several reasons: First of all, and that is the main intention of the book, it serves as a comprehensive text for teaching and learning knot theory. Moreover it provides a model for cooperation between mathematicians and mathematics educators based on substantial mathematics. And finally it is a thorough introduction to the Japanese art of lesson studies–again in the context of substantial mathematics.

Lecture notes for graduates or researchers wishing to enter this modern field of research.

This book is a comprehensive study of the life and mathematics of Walter Noll, who helped to create the mathematical tools of modern rational mechanics and thermodynamics. Noll is one of the brilliant mathematicians of the second part of the 20th century. His contribution is large in both the applied and pure mathematics. The book stresses particularly Noll's method of axiomatization of physical theories, his axiomatics of continuum mechanics, thermodynamics of materials, special relativity theory, his discovery of the neo-classical space-time of mechanics, his theories of inhomogeneities in simple bodies, fit regions, contact interactions, annihilators of linear differential operators, and finite-dimensional spaces. It is a must for every mathematician, physicist, engineer or graduate student as a reference and key to Noll's mathematical heritage.

Statistical Society of Australia NewsletterMathematics Unlimited - 2001 and BeyondSpringer

This volume contains the proceedings of a NATO/London Mathematical Society Advanced Study Institute held in Oxford from 25 July - 7 August 1982. The institute concerned the theory and applications of systems of nonlinear partial differential equations, with emphasis on techniques appropriate to systems of more than one equation. Most of the lecturers and participants were analysts specializing in partial differential equations, but also present were a number of numerical analysts, workers in mechanics, and other applied mathematicians. The organizing committee for the institute was J.M. Ball (Heriot-Watt), T.B. Benjamin (Oxford), J. Carr (Heriot-Watt), C.M. Dafermos (Brown), S. Hildebrandt (Bonn) and J.S. pym (Sheffield) . The programme of the institute consisted of a number of courses of expository lectures, together with special sessions on different topics. It is a pleasure to thank all the lecturers for the care they took in the preparation of their talks, and S.S. Antman, A.J. Chorin, J.K. Hale and J.E. Marsden for the organization of their special sessions. The institute was made possible by financial support from NATO, the London Mathematical Society, the u.S. Army Research Office, the u.S. Army European Research Office, and the u.S. National Science Foundation. The lectures were held in the Mathematical Institute of the University of Oxford, and residential accommodation was provided at Hertford College.

A collection of articles discussing integrable systems and algebraic geometry from leading researchers in the field.

Mapping class groups and moduli spaces of Riemann surfaces were the topics of the Graduate Summer School at the 2011 IAS/Park City Mathematics Institute. This book presents the nine different lecture series comprising the summer school, covering a selection of topics of current interest. The introductory courses treat mapping class groups and Teichmüller theory. The more advanced courses cover intersection theory on moduli spaces, the dynamics of polygonal billiards and moduli spaces, the stable cohomology of mapping class groups, the structure of Torelli groups, and arithmetic mapping class groups. The courses consist of a set of intensive short lectures offered by leaders in the field, designed to introduce students to exciting, current research in mathematics. These lectures do not duplicate standard courses available elsewhere. The book should be a valuable resource for graduate students and researchers interested in the topology, geometry and dynamics of moduli spaces of Riemann surfaces and related topics. Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price.

In this volume are collected notes of lectures delivered at the First In ternational Research Institute of the Mathematical Society of Japan. This conference, held at Tohoku University in July 1993, was devoted to geometry and global analysis. Subsequent to the conference, in answer to popular de mand from the participants, it was decided to publish the notes of the survey lectures. Written by the lecturers themselves, all experts in their respective fields, these notes are here presented in a single volume. It is hoped that they will provide a vivid account of the current research, from the introduc tory level up to and including the most recent results, and will indicate the direction to be taken by future researeh. This compilation begins with Jean-Pierre Bourguignon's notes entitled "An Introduction to Geometric Variational Problems," illustrating the gen eral framework of the field with many examples and providing the reader with a broad view of the current research. Following this, Kenji Fukaya's notes on "Geometry of Gauge Fields" are concerned with gauge theory and its applications to low-dimensional topology, without delving too deeply into technical detail. Special emphasis is placed on explaining the ideas of infi nite dimensional geometry that, in the literature, are often hidden behind rigorous formulations or technical arguments.

This book contains written versions of the lectures given at the PCMI Graduate Summer School on the representation theory of Lie groups. The volume begins with lectures by A. Knapp and P. Trapa outlining the state of the subject around the year 1975, specifically, the fundamental results of Harish-Chandra on the general structure of infinite-dimensional representations and the Langlands classification. Additional contributions outline developments in four of the most active areas of research over the past 20 years. The clearly written articles present results to date, as follows: R. Zierau and L. Barchini discuss the construction of representations on Dolbeault cohomology spaces. D. Vogan describes the status of the Kirillov-Kostant ``philosophy of coadjoint orbits'' for unitary representations. K. Vilonen presents recent advances in the Beilinson-Bernstein theory of ``localization''. And Jian-Shu Li covers Howe's theory of ``dual reductive pairs''. Each contributor to the volume presents the topics in a unique, comprehensive, and accessible manner geared toward advanced graduate students and researchers. Students should have completed the standard introductory graduate courses for full comprehension of the work. The book would also serve well as a supplementary text for a course on introductory infinite-dimensional representation theory.

The goal of this textbook is to introduce students to the stochastic analysis tools that play an increasing role in the probabilistic approach to optimization problems, including stochastic control and stochastic differential games. While optimal control is taught in many graduate programs in applied mathematics and operations research, the author was intrigued by the lack of coverage of the

theory of stochastic differential games. This is the first title in SIAM?s Financial Mathematics book series and is based on the author?s lecture notes. It will be helpful to students who are interested in stochastic differential equations (forward, backward, forward-backward); the probabilistic approach to stochastic control (dynamic programming and the stochastic maximum principle); and mean field games and control of McKean?Vlasov dynamics. The theory is illustrated by applications to models of systemic risk, macroeconomic growth, flocking/schooling, crowd behavior, and predatory trading, among others.

The nature of interactions between mathematicians and physicists has been thoroughly transformed in recent years. String theory and quantum field theory have contributed a series of profound ideas that gave rise to entirely new mathematical fields and revitalized older ones. The influence flows in both directions, with mathematical techniques and ideas contributing crucially to major advances in string theory. A large and rapidly growing number of both mathematicians and physicists are working at the string-theoretic interface between the two academic fields. The String-Math conference series aims to bring together leading mathematicians and mathematically minded physicists working in this interface. This volume contains the proceedings of the inaugural conference in this series, String-Math 2011, which was held June 6-11, 2011, at the University of Pennsylvania.

The first volume (General Theory) differs from most textbooks as it emphasizes the mathematical structure and mathematical rigor, while being adapted to the teaching the first semester of an advanced course in Quantum Mechanics (the content of the book are the lectures of courses actually delivered.). It differs also from the very few texts in Quantum Mechanics that give emphasis to the mathematical aspects because this book, being written as Lecture Notes, has the structure of lectures delivered in a course, namely introduction of the problem, outline of the relevant points, mathematical tools needed, theorems, proofs. This makes this book particularly useful for self-study and for instructors in the preparation of a second course in Quantum Mechanics (after a first basic course). With some minor additions it can be used also as a basis of a first course in Quantum Mechanics for students in mathematics curricula. The second part (Selected Topics) are lecture notes of a more advanced course aimed at giving the basic notions necessary to do research in several areas of mathematical physics connected with quantum mechanics, from solid state to singular interactions, many body theory, semi-classical analysis, quantum statistical mechanics. The structure of this book is suitable for a second-semester course, in which the lectures are meant to provide, in addition to theorems and proofs, an overview of a more specific subject and hints to the direction of research. In this respect and for the width of subjects this second volume differs from other monographs on Quantum Mechanics. The second volume can be useful for students who want to have a basic preparation for doing research and for instructors who may want to use it as a basis for the presentation of selected topics.

"Analytic and algebraic geometers often study the same geometric structures but bring different methods to bear on them. While this dual approach has been spectacularly successful at solving problems, the language differences between algebra and analysis also represent a difficulty for students and researchers in geometry, particularly complex geometry. The PCMI program was designed to partially address this language gulf, by presenting some of the active developments in algebraic and analytic geometry in a form suitable for students on the 'other side' of the analysis-algebra language divide. One focal point of the summer school was multiplier ideals, a subject of wide current interest in both subjects. The present volume is based on a series of lectures at the PCMI summer school on analytic and algebraic geometry. The series is designed to give a high-level introduction to the advanced techniques behind some recent developments in algebraic and analytic geometry. The lectures contain many illustrative examples, detailed computations, and new perspectives on the topics presented, in order to enhance access of this material to non-specialists."--Publisher's description.

Functionals involving both volume and surface energies have a number of applications ranging from Computer Vision to Fracture Mechanics. In order to tackle numerical and dynamical problems linked to such functionals many approximations by functionals defined on smooth functions have been proposed (using high-order singular perturbations, finite-difference or non-local energies, etc.) The purpose of this book is to present a global approach to these approximations using the theory of gamma-convergence and of special functions of bounded variation. The book is directed to PhD students and researchers in calculus of variations, interested in approximation problems with possible applications.

Langlands program proposes fundamental relations that tie arithmetic information from number theory and algebraic geometry with analytic information from harmonic analysis and group representations. This title intends to provide an entry point into this exciting and challenging field.

The volume gives a balanced overview of the current status of probability theory. An extensive bibliography for further study and research is included. This unique collection presents several important areas of current research and a valuable survey reflecting the diversity of the field.

Geometric group theory refers to the study of discrete groups using tools from topology, geometry, dynamics and analysis. The field is evolving very rapidly and the present volume provides an introduction to and overview of various topics which have played critical roles in this evolution. The book contains lecture notes from courses given at the Park City Math Institute on Geometric Group Theory. The institute consists of a set of intensive short courses offered by leaders in the field, designed to introduce students to exciting, current research in mathematics. These lectures do not duplicate standard courses available elsewhere. The courses begin at an introductory level suitable for graduate students and lead up to currently active topics of research. The articles in this volume include introductions to CAT(0) cube complexes and groups, to modern small cancellation theory, to isometry groups of general CAT(0) spaces, and a discussion of nilpotent genus in the context of mapping class groups and CAT(0) groups. One course surveys quasi-isometric rigidity, others contain an exploration of the geometry of Outer space, of actions of arithmetic groups, lectures on lattices and locally symmetric spaces, on marked length spectra and on expander graphs, Property tau and approximate groups. This book is a valuable resource for graduate students and researchers interested in geometric group theory. Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price.

This book had its origins in the NATO Advanced Study Institute (ASI) held in Ohrid, Macedonia, in 2014. The focus of this ASI was the arithmetic of superelliptic curves and their application in different scientific areas, including whether all the applications of hyperelliptic curves, such as cryptography, mathematical physics, quantum computation and diophantine geometry, can be carried over to the superelliptic curves. Additional papers have been added which provide some background for readers who were not at the conference, with the intention of making the book logically more complete and easier to read, but familiarity with the basic facts

of algebraic geometry, commutative algebra and number theory are assumed. The book is divided into three sections. The first part deals with superelliptic curves with regard to complex numbers, the automorphisms group and the corresponding Hurwitz loci. The second part of the book focuses on the arithmetic of the subject, while the third addresses some of the applications of superelliptic curves.

In inverse problems, the aim is to obtain, via a mathematical model, information on quantities that are not directly observable but rather depend on other observable quantities. Inverse problems are encountered in such diverse areas of application as medical imaging, remote sensing, material testing, geosciences and financing. It has become evident that new ideas coming from differential geometry and modern analysis are needed to tackle even some of the most classical inverse problems. This book contains a collection of presentations, written by leading specialists, aiming to give the reader up-to-date tools for understanding the current developments in the field.

Leading experts introduce this classical subject with exciting new applications in theoretical physics.

This volume includes expanded versions of the lectures delivered in the Graduate Minicourse portion of the 2013 Park City Mathematics Institute session on Geometric Analysis. The papers give excellent high-level introductions, suitable for graduate students wishing to enter the field and experienced researchers alike, to a range of the most important areas of geometric analysis. These include: the general issue of geometric evolution, with more detailed lectures on Ricci flow and Kähler-Ricci flow, new progress on the analytic aspects of the Willmore equation as well as an introduction to the recent proof of the Willmore conjecture and new directions in min-max theory for geometric variational problems, the current state of the art regarding minimal surfaces in R3, the role of critical metrics in Riemannian geometry, and the modern perspective on the study of eigenfunctions and eigenvalues for Laplace–Beltrami operators.

New Scientist magazine was launched in 1956 "for all those men and women who are interested in scientific discovery, and in its industrial, commercial and social consequences". The brand's mission is no different today - for its consumers, New Scientist reports, explores and interprets the results of human endeavour set in the context of society and culture.

This compact textbook is a collection of the author’s lecture notes for a two-semester graduate-level real analysis course. While the material covered is standard, the author’s approach is unique in that it combines elements from both Royden’s and Folland’s classic texts to provide a more concise and intuitive presentation. Illustrations, examples, and exercises are included that present Lebesgue integrals, measure theory, and topological spaces in an original and more accessible way, making difficult concepts easier for students to understand. This text can be used as a supplementary resource or for individual study.

A co-publication of the AMS, IAS/Park City Mathematics Institute, and Society for Industrial and Applied Mathematics Articles in this volume are based on lectures presented at the Park City summer school on “Mathematics and Materials” in July 2014. The central theme is a description of material behavior that is rooted in statistical mechanics. While many presentations of mathematical problems in materials science begin with continuum mechanics, this volume takes an alternate approach. All the lectures present unique pedagogical introductions to the rich variety of material behavior that emerges from the interplay of geometry and statistical mechanics. The topics include the order-disorder transition in many geometric models of materials including nonlinear elasticity, sphere packings, granular materials, liquid crystals, and the emerging field of synthetic self-assembly. Several lectures touch on discrete geometry (especially packing) and statistical mechanics. The problems discussed in this book have an immediate mathematical appeal and are of increasing importance in applications, but are not as widely known as they should be to mathematicians interested in materials science. The volume will be of interest to graduate students and researchers in analysis and partial differential equations, continuum mechanics, condensed matter physics, discrete geometry, and mathematical physics. Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price. NOTE: This discount does not apply to volumes in this series co-published with the Society for Industrial and Applied Mathematics (SIAM).

The lectures in this volume provide a perspective on how 4-manifold theory was studied before the discovery of modern-day Seiberg-Witten theory. One reason the progress using the Seiberg-Witten invariants was so spectacular was that those studying $SU(2)$-gauge theory had more than ten years' experience with the subject. The tools had been honed, the correct questions formulated, and the basic strategies well understood. The knowledge immediately bore fruit in the technically simpler environment of the Seiberg-Witten theory. Gauge theory long predates Donaldson's applications of the subject to 4-manifold topology, where the central concern was the geometry of the moduli space. One reason for the interest in this study is the connection between the gauge theory moduli spaces of a Kahler manifold and the algebro-geometric moduli space of stable holomorphic bundles over the manifold. The extra geometric richness of the $SU(2)$-moduli spaces may one day be important for purposes beyond the algebraic invariants that have been studied to date. It is for this reason that the results presented in this volume will be essential.

Since their inception, the Perspectives in Logic and Lecture Notes in Logic series have published seminal works by leading logicians. Many of the original books in the series have been unavailable for years, but they are now in print once again. This volume, the seventeenth publication in the Lecture Notes in Logic series, collects the proceedings of the European Summer Meeting of the Association for Symbolic Logic, held in Utrecht, The Netherlands in August, 1999. It includes surveys and research articles from some of the world's preeminent logicians. Two long articles are based on tutorials given at the meeting and present accessible expositions of current research in geometric model theory and the descriptive set theory of group actions. The other articles cover current research topics in all areas of mathematical logic, including proof theory, set theory, model theory, computability theory and philosophy.

This is a book guaranteed to delight the reader. It not only depicts the state of mathematics at the end of the century, but is also full of remarkable insights into its future de- velopment as we enter a new millennium. True to its title, the book extends beyond the spectrum of mathematics to in- clude contributions from other related sciences. You will enjoy reading the many stimulating contributions and gain insights into the astounding progress of mathematics and the perspectives for its future. One of the editors, Björn Eng- quist, is a world-renowned researcher in computational sci- ence and engineering. The second editor, Wilfried Schmid, is a distinguished mathematician at Harvard University. Likewi- se the authors are all foremost mathematicians and scien- tists, and their biographies and photographs appear at the end of the book. Unique in both form and content, this is a "must-read" for every mathematician and scientist and, in particular, for graduates still choosing their specialty. Limited collector's edition - an exclusive and timeless work. This special, numbered edition will be available until June 1, 2000. Firm orders only.

This is the third volume in the Paris-Princeton Lectures in Financial Mathematics, which publishes, on an annual basis, cutting-edge research

in self-contained, expository articles from outstanding specialists, both established and upcoming. Coverage includes articles by René Carmona, Ivar Ekeland/Erik Taflin, Arturo Kohatsu-Higa, Pierre-Louis Lions/Jean-Michel Lasry, and Huyên Pham.