describes the importance of intercellular signalling mediated by small peptides. The review traces the biosynthesis of these peptides, their post-translational modification, proteolytic processing and finally formation of biologically functional protein.

A few reviews deal with various aspects of genetics and genome evolution. The diversity and role of small RNAs like DCl (Dicer-like), AGO1, HEN1, etc. along with their biogenesis and role in gene silencing are reviewed by Bologna and Voinnet. Bennetzen and Wang describe different types of transposable elements, their origins, specificities and regulation. Huang and Han discuss natural and artificial variations which lead to crop improvement. They also discuss how crop genome studies and advancements in sequencing techniques, sequencing-based genotyping and genome-wide association studies have aided in crop development and domestication.

As always, reviews related to some upcoming field of research are also included. The topic chosen in this volume is plant molecular pharming, which is reviewed exceptionally well by Stoger *et al*. Plant molecular pharming is used for production of pharmaceutical products required in the treatment of chronic and infectious diseases, especially where these products are required in large quantities in a short span of time. The authors also bring out the challenges involved, need of further optimization of product isolation, etc. Plant molecular pharming can be of great help with the increasing population and higher demand for medicines in large quantities and affordable rates.

Thus, the *ARBP* continues to provide a comprehensive view of research topics and challenges lying ahead, which are of interest to both freshers and esteemed researchers alike.

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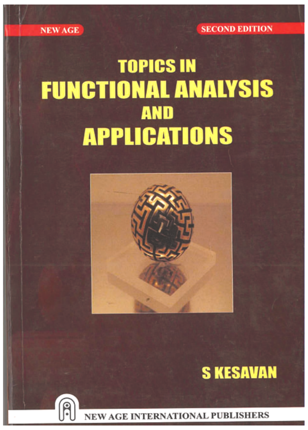

Topics in Functional Analysis and Applications. S. Kesavan. New Age International (P) Limited, 7/30A, Daryaganj, New Delhi 110 002. 2015. 2nd edn. xi + 247 pp. Price: Rs 250.

The first thing one notices about this book is that the preface is the same as that of the first edition which was published way back in 1989. While it is good to keep the original preface, it would have been better to add a new one for the second edition.

The title of this book should have been '*Topics in Partial Differential Equations with Applications*' because this book is really on that topic. This book by Kesavan, is a landmark text by an Indian author in the theory of partial differential equations (PDEs). The foremost reason is that it is the very first book in this country to treat the topic of PDE using distribution theory as far as the present reviewer is aware. Treatment of PDEs draws resources from many sub-disciplines, which come under the broad umbrella of functional analysis. Among these, the most important is the theory of distribution. The challenge that a teacher of PDEs faces is the following. If he/she dwells too much on the theory of distributions, then the students wonder why they have to go through this advanced and fairly difficult diversion, before they can reach their own topic of interest, viz. PDEs. And the students of such a course might comprise of pursuants of physics and engineering, apart from mathematics, because PDEs have widespread applications. Of course, it is by now folklore among mathematicians, that the best way to handle PDEs is through the theory of distributions; that is what Laurent Scwartz has shown. It might be a tad too presumptuous to preach that to students of a mixed background. Thus for a teacher of a one-semester course in PDEs, this becomes a dilemma – the researcher in her wants to follow the rigorous and beautiful treatment in the style of Laurent Schwartz and the teacher in her wants to quickly get to the point to satisfy the students' curiosities. Kesavan's book, which originated from teaching such a course, takes care of this by treating distribution theory in the first chapter in a manner which is essential, not too technical and rigorous. He avoids the finer details of the inductive limit topology and sticks to the basics of how a sequence of distributions converges. Needless to say, an initiated reader can take-off from there, if the beautiful theory of distributions catches his/her fancy and can read from Walter Rudin's book, *Functional Analysis*.

Once the distribution theory is over, the book spends a considerable amount of effort on Sobolev spaces, again something basic, that a student of PDEs would require. The discussions on PDEs start from chapter 3, where examples of elliptic boundary-value problems are solved.

While it is well known that many physical situations give rise to PDEs (often through variational problems), it takes a deep look to solving these PDEs to realize the importance of several mathematical techniques that are often interesting in their own right. One such technique is approximation by smooth functions. At first sight, it strikes a reader as quite a marvel that Dirac delta function can be approximated (and motivated) well by successive normal densities with lesser and lesser standard deviations. Far-reaching generalizations of such ideas, using mollifiers and convolution, are explained in this book with great lucidity.

Several of the concepts discussed in this book had their origin in physics. An early inquiry at the time of beginning of quantum mechanics was about all possible (irreducible) representations of the so-called canonical commutation relations (CCR). It was important to know this because position and momentum satisfied CCR; so one would obviously have to know all its representations. However, Heisenberg's CCR presented a certain subtle challenge – one had to be careful about domains of the unbounded self-adjoint operators that were involved. Weyl had the ingenious idea of studying the CCR in the form of one-parameter groups, i.e. he found a way of exponentiating an unbounded self-adjoint operator. Weyl's form of CCR quickly led to the celebrated theorem of Stone and von Neumann which characterized the irreducible representations of CCR. It also opened up the converse question, i.e. whether all such one-parameter groups are obtained by exponentiation. In a number of papers between 1930 and 1932, Stone and von Neumann studied the one-parameter unitary groups. Although their works are closely related, what goes by the name of Stone's theorem is the stunning result that a one-parameter, strongly continuous unitary group admits a derivative. Note that the assumption is only about continuity, whereas the conclusion is differentiability. This theorem has found innumerable applications, including in PDEs. Thus, it was a natural question to investigate one-parameter semigroups on a Banach space. The Hille–Yosida theorem generalizes Stone's theorem to strongly continuous one-parameter semigroups of contractions on a Banach space. This piece of classical mathematics is done in chapter 4 of the book. It is then applied to solve the heat equation, an example of a parabolic PDE; the wave equation, an example of a hyperbolic PDE and the Schrödinger equation. The treatment is rudimentary and sticks to the basics as is desirable in a first course. I have two criticisms here. The first is that the notes section at the end of this chapter could include a bit of the history of early quantum mechanics and its contribution to the development of the material in this chapter. That would not be directly related to PDEs perhaps, but would not be too far-fetched either. All the three equations mentioned above and treated in this chapter originate from physics. The second is about proof-reading of this chapter. It could have been much more stringent. The minus sign in $S(t - s)$ is missing in at least three places on p. 189. Also on p. 188, in eqs (4.8.4) and (4.8.5), minus signs are missing. The typographical errors on p. 188 are a little serious, because a new reader might get confused.

Approximation tools like Galerkin methods have been sufficiently elucidated in this book. Such discretization is essential. Also, the book has a section called 'Comments' at the end of each chapter, which greatly helps a motivated reader. In the Comments section, the author gives reference to texts which have more detailed treatments of some of the topics covered in that chapter. This is required, because the book, which is designed as a one-semester introduction, obviously cannot afford to dwell far too long on certain topics, which are necessary for treating PDEs, but have also developed into full-fledged subjects on their own. The finite element method is one such topic. For such topics, good references are pointed out in the Comments section, so that a student can pursue whatever catches his/her fancy.

To summarize, this is an invaluable book for a course in PDEs for Ph D students. On a lighter note, the present reviewer noticed the use of the word 'Reciprocally' at places, whereas the standard mathematical terminology is to use 'conversely'. This deviation is perhaps due to Kesavan's proficiency in French and hence 'Reciproquement'.

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