Reviews

Fundamentals of university mathematics, (3rd edn.), Colin McGregor, Jonathan Nimmo and the late Wilson Stothers. Pp. 551. £40 (pbk). 2010. ISBN 978-0-85709-223-6 (print), 978-0-85709-224-3 (online) (Woodhead Publishing Paperback).

The mathematics in this book was taught in 100 one-hour lectures to students at Glasgow university, before the courses there became modular. The topics are broadly algebra, including trigonometry, complex numbers, linear algebra and a little two-and three-dimensional geometry via vectors; and calculus up to first order ordinary and second order linear differential equations. The way in which this has been compressed into one volume weighing under 1kg (rather than, in the American style, into three volumes each weighing twice as much) is by sticking firmly to the matter in hand, avoiding digressions and the temptation to jump on hobby-horses. The result is probably fairly daunting for a first-year undergraduate, but all the essentials are there, with enough 'rigour' to satisfy most first year courses. (I can believe that large parts of the book would be rewarding too for a well-motivated school student studying Mathematics or, especially, Further Mathematics at A level.) A sufficiently rigorous introduction to limits and continuity is indeed included in an appendix, and the sensible decision is taken to introduce limits in an intuitive way in the main text and then to use these results to discuss continuity, differentiation etc. in fairly formal terms. Results are carefully stated; for example the index law $(x^p)^q = x^{pq}$ (in Chapter 1 for rational p, q) requires both x^p and x^q to be defined, so that $((-5)^2)^{3/2}$ cannot be evaluated as $(-5)^3$. There are many other enlightening examples in the early work, such as evaluating $\sqrt{2^{2^{100}}}$. Examples in the text are fully worked, 'problems' in the text are provided with full solutions, and there are 'exercises' at the ends of chapters. Ideas and results which might cause particular trouble are signalled by a 'warning' sign with an exclamation mark inside a triangle. The book is entirely about the subjects mentioned; there is almost no number theory and no group theory: it is a book of mathematical methods with added rigour.

Here are a few specific remarks. The treatment of functions, with domain, codomain and 'rule', and a detailed discussion of associativity of composition, injectivity and the rest, would probably look particularly overpowering to someone used to a purely intuitive idea of functions. I hope that a teacher or lecturer presenting this topic would be able to pass lightly over the technicalities. Complex numbers are introduced as pairs of real numbers with specific addition and multiplication rules, and $e^{i\theta}$ is called the 'complex exponential' and defined as $\cos\theta + i\sin\theta$, with properties established to make the notation reasonable. There is a nice section on curve sketching, including implicit curves, and singular parametric curves. Inverting matrices is done by row operations and reduced echelon form, so I did not find any mention of cofactors or Cramer's rule, which may come as a shock to some, but is another illustration of the very focussed approach of this book. Integration is treated in a traditional way, with indefinite integration as anti-differentiation, areas under curves being defined by limits of Riemann sums, and the two brought together by the 'fundamental theorem of calculus'. In the section on Taylor (Maclaurin) series there is a hazard warning about functions such as $\exp(-1/x^2)$ not represented by their series (though the verification is understandably not given), and the authors resist the temptation to refer back to $e^{i\theta}$ having found series for exp, sin and cos.

So, this is a book which gives you everything without fuss and without embellishment, with sufficient rigour for its intended audience and with ample warnings of the pitfalls awaiting the unwary.

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