BOOK REVIEW

Introduction to Cell Mechanics and Mechanobiology, edited by Christopher R. Jacobs, Hayden Huang, and Ronald Y. Kwon. 1st ed., Garland Science, New York, NY, USA, 2012, 350 pp., ISBN 9780815344254

This excellent book by a group of internationally-recognised authors meets a real existing need in contemporary bioengineering education, and it does it effectively and successfully. I will begin my review by describing a personal experience with this book. Last year, I was asked to teach for the first time an advanced, elective (3rd/4th year) course that has been offered for undergraduate students in our Department of Biomedical Engineering (BME) at Tel Aviv University for several years now – Cell and Tissue Engineering. It was felt that the course is somewhat lacking rigorous engineering fundamentals, and that it is too much biased towards the biology aspects. Accordingly, I have decided that my revised course will be focusing on the engineering and basic science aspects of cell and tissue engineering, and the biology will be described where relevant and needed, but not to the depth and breadth at which it would have been provided if this was a course in a Life Sciences program. With that in mind I started looking for bioengineering textbooks that adequately cover mechanobiology, cellular mechanics or cellular engineering, only to find out that the available textbooks generally take the traditional biomechanics approach, which means that continuum mechanics is used to address whole-body or tissue-scale problems, with very little to none on cell-scale problems. It was at about this time where I received a copy of Introduction to Cell Mechanics and Mechanobiology with a request for review, which was an exceptionally fortunate coincidence. This book was exactly what I wanted; it was entirely devoted to cell-scale problems, with numerous examples, each providing the relevant engineering or mathematical formulation, at a level suitable for good undergrad BME students. I started using the book for in-class problems, which were all well-received, and when teaching some classes, e.g. on cell migration, I was relying heavily on the book. So, I can certainly say that I have tested this book personally, 'in field conditions,' and was very pleased with the outcomes.

The book contains 11 chapters, on topics such as experimental approaches to cell mechanics, plasma membrane mechanics, cell adhesion, migration, and contraction, and mechanical signaling. The authors wisely structured the book in two parts. In the first part they provide the fundamentals, that is, the relevant topics in cell biology, solid and fluid mechanics, and statistical mechanics. In the second part they focus on the specifics, on applications and on more practical issues for those involved in mechanobiology work, e.g. the relevant laboratory approaches, description of the polymer network behaviour of the cytoskeleton and mechanotransduction. The authors inherently assume that at the stage of using the book, the students have already learned calculus, differential and integral equations, and basic engineering courses such as statics, dynamics, solid and fluid mechanics, which means that the book is clearly targeting undergraduate students at their senior years, and also perhaps graduate level students in some cases. All chapters are comprehensible, logically-built and concise, and each is supported by high-quality graphics which add very much to the clarity of the contents. To further aid the learning experience, chapters contain ‘key concept’ blocks that summarise the take-home-messages from the relevant chapters, and there are also problems that build-on the material in each chapter but then challenge the student/reader to think about how to implement the knowledge to variant or new situations.

Example problems with solutions are integrated in many places, and these are thoroughly analysed by means of quantitative engineering theory and models which are based on empirical data. Personally, I find this collection of problems enormously useful for teaching, as in many tissue engineering textbooks, e.g. there is a tendency to move away from mathematical formulations or engineering theories and to take a more descriptive, qualitative approach which is perhaps characteristic to the life sciences but creates a serious discrepancy in educating BME students.

As said above, I already had an excellent experience in implementing the material in Introduction to Cell Mechanics and Mechanobiology book in class, and I will certainly continue to use it as one of the main textbooks in this course. Some parts of the book are also suitable for graduate courses in cell biomechanics and tissue engineering, particularly as an introduction or background material.

Computer Methods in Biomechanics and Biomedical Engineering, 2015
Vol. 18, No. 2, 221–222, http://dx.doi.org/10.1080/10255842.2013.780048
For anyone having engineering or a basic science background and who is entering the field of mechanobiology, this book is a ‘must-have’. Faculties who teach cell and tissue engineering courses should consider having it as one of their main textbooks, particularly if the intended teaching approach is a quantitative one. Finally, considering the developments of the last few years in the field of tissue engineering, which gradually but steadily shifts weight from trial-and-error qualitative biology into theoretically-planned or theoretically-supported, quantitative engineering work, this book is a necessary addition for updating the library of those involved in mechanobiology, mechanotransduction and tissue engineering research.

Amit Gefen
Associate Professor in Biomedical Engineering
Department of Biomedical Engineering
Faculty of Engineering, Tel Aviv University
Tel Aviv 69978 Israel
E-mail: gefen@eng.tau.ac.il
© 2013, Amit Gefen