PKU Globex Julmester®

Finite Element Modelling for Structural Integrity & Biological Applications (3 Credits)

有限元建模在结构完整性和生物学上的应用

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Synopsis	Finite element modelling is a powerful computational method which is the cornerstone of modern design. Amongst other things, it enables accurate prediction of a mechanical behavior of structures enabling prediction of structural integrity through mechanical yield, thermal strain, fracture and fatigue. It is particularly useful in industries such as the aerospace, nuclear and biomedical devices which have high design constraints and where prototype testing is particularly challenging. A new area where finite element modelling is being applied is to understand the behavior of biological tissue such as teeth, bone and human organs, which have unique multiscale design, and the effect of factors such as disease, exercise and damage.	
Offering	2017 Julmester (July Semester)	
Audience	Year 3 & 4 Undergraduate and Graduate Students	
Classroom	Room xxx, Teaching Bldg. No. XX, Peking University	
Schedule	Class: 1-4 PM, M-F, July 3–21, 2017	Total Contact Hours: 45 / Final Exam: 1-3 PM, July 22, 2017
Objective	To understand the principles of finite element modelling and its application to real world problems, particularly those associated with structural integrity and biological applications and the associated complex design scenarios. By the end of the course students will have the skills to apply finite element modelling to a wide range of scenarios applicable in both research and professional design.	
Topics	1. ***Review of Finite Element Method (FEM) fundamentals***: The principles behind finite element modelling, the underlining mathematical principles and examples of application to real life situations. 2. ***Creation of FEM elements, linear analysis in solid and structural mechanics***: application of the displacement-based finite element method for the creation of stiffness matrices for bars and plates, solution methods for finite element problems. 3. ***Applications of finite element modelling for structural integrity***: Prediction of stress and strain from displacement method, fracture and off-nodal loading. Integration of structural and thermal analyses. 4. ***FEM applications for composite materials***: non-isotropic materials behavior, models for determining degradation and failure. 5. ***Biological materials and multiscale FEM***: the multiscale structure of biological materials and the design of multiscale finite element models. Application of multiscale FEM for predicting the influence degradation of tissue under mechanical loading. Real-life examples. 6. ***Future applications***: Opportunities for the application of FEM in other scenarios such as civil structures and biomedical devices.	
References	1. Cook, R. D., Malkus, D. S., Plesha, M. E., Witt, R. J. (2002). Concepts and Applications of Finite Element Analysis, 4 th Ed, John Wiley & Sons. 2. Chandrupatla, T. R., Belegundu, A. D. (2011) Introduction to Finite Elements in Engineering, 4th Ed, Prentice Hall (Pearson) 3. J. Fish, T. Belytschko, (2007) A First Course in Finite Elements (2007) Wiley & Sons	
Grading	Homework Assignments 20% Project Assignment 30% • *Interim Project Assessment* (10%) • *Final Project Assessment* (20%) Midterm Exam 10% Final Exam 40% Total 100%	