Purpose of the course and its significance for your engineering education:

The course will elucidate the formulation, solution, and application of problems related to design of composite and sandwich structures. These problems are of vital importance in such diverse areas as aerospace, mechanical, marine, biomedical and civil engineering. For example, composite and sandwich construction is used in the fuselage, wings and control surfaces of modern planes, superstructures and radar enclosures of naval ships are often built using sandwich structures, and elements of buildings are constructed using sandwich panels to provide both thermal insulation and structural efficiency. The tendon-to-bone insertion site, arterial walls and brain tissues represent examples of natural composite materials investigated in biomechanics.

The purpose of the course is to prepare engineers to solve practical problems associated with design of composite structures. In addition, the course provides the necessary theoretical foundations for researchers working with such structures. After the completion of the course you should be able to design composite structures, perform the analysis using available solutions, understand manuals of software used for design of composite structures, intelligently prepare the input and analyze the output from a FEA analysis, and assess the applicability and limitations of finite element packages and theories. The emphasis in the course is on the concepts and their applications.

Subjects:

The course includes both material and structure-oriented aspects of composites.

Chapter 1: Review of Basic Concepts

Chapter 2: Miscellaneous Aspects of Analysis of Laminated Structures

Chapter 3: Laminate bolted and bonded joints

Chapter 4: Analysis of Discontinuous Fiber-Reinforced Composites: Engineering Approach

Chapter 5: Foundations of Micromechanics of Composite Materials

Chapter 6: Micromechanical Approach to Strength of a Lamina

Chapter 7: Sandwich structures

Chapter 8: Selected Topics of Composite Material Structures (optional, dependent on time availability).
Projects:

This is a 400-level course and the students must illustrate that they are capable of solving practical problems. Accordingly, standard homework assignments and tests will be replaced with four industrial projects. The student has to independently work on the project during several weeks and submit a report with the solution. The report should resemble a typical report in industry, i.e. it must be typed, written in a clear and logical language and contain all necessary references. The report should have a section of conclusions outlining the problem, identifying important tendencies (effects of various design variables) and providing practical recommendations for design of the component.

Instructor:

Professor Victor Birman works in the areas of composite material structures, biomechanics, smart structures, buckling and dynamics. He published over 300 research papers in archival journals, book chapters and conference proceedings. Research of Prof. Birman was sponsored by the Air Force, Air Force Office of Scientific Research, Army Research Office, Office of Naval Research, US Department of Transportation, Missouri Department of Transportation, Navy, National Institutes of Health, NASA, and industry. He serves as Associate Editor of several journals and as a reviewer for over 25 journals, several publishing companies and agencies. Professor Birman is a Fellow and member of several committees of the American Society of Mechanical Engineers and Associate Fellow of the American Institute of Aeronautics and Astronautics.

The monograph of Dr. Birman “Plate Structures” was published by Springer in July 2011. He is also a co-author of the book “Structural Interfaces and Attachments in Biology” that was published by Springer in the Fall 2013.