Stability of Engineering Structures AE/ME 5234

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

Problems of stability are among the most important issues engineers have to address when they are involved in design of structures. These problems are encountered in aerospace, marine, and civil engineering as well as in practically all applications of mechanical engineering. The course will elucidate the formulation, solution, and applications of problems related to stability of structures and design aspects accounting for stability.

The purpose of the course is both to prepare engineers to solve practical problems as well as to provide necessary theoretical foundations for researchers working in the field of stability of structures. After the completion of the course you will be able to design or check the stability of columns, plates and shells. You will be prepared to apply and develop analytical solutions as well as understand stability related aspects of manuals of software used in design of structures. In addition, you will be able to assess the applicability and limitations of finite element packages used in design of structures that encounter buckling problems. Also, you will better understand the use, limitations and appropriateness of standard solutions in handbooks and structural manuals. The emphasis in the course is on the concepts and their applications.

References:

The first four chapters of the course are based on the textbook by Professor Robert M. Jones “Buckling of Bars, Plates, and Shells,” Bull Ridge Publishing, Blacksburg, Virginia, 2006.

Two last chapters are based on various sources, including the following excellent books on the subject:


Unfortunately, the older books listed above are out-of-print. More recent books on the subject include (for various reasons they are not suitable as textbooks for the present course):

The slides uploaded to Blackboard represent the entire set of course materials and provide all necessary information for enrolled students. Additional information will be sent to you as needed.

Projects:

This course involves rather advanced mathematical formulations that are applied to the solution of typical stability problems. The goal of the instructor is to provide you with a clear understanding of the subject. Upon the completion of the course you should be able to solve typical problems, comprehend the approach to their solution and be prepared for research in the field of stability in case you pursue your graduate studies in this area. The major emphasis is on the solution of practical problems applying available solutions to design of structures manufactured from such isotropic materials as steel, aluminum, titanium, etc. Accordingly, standard homework assignments and tests will be replaced with four industrial projects. The student has to work on each project during several weeks and submit a report with the solution. The report should resemble a report in industry, i.e. it must be typed, written in a clear and logical language, contain all necessary equations and 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. A sample project will be made available to the students to help them to prepare their report in an appropriate format.

The projects will be placed on Blackboard. Every student will be contacted individually with comments and assessment of his or her project. If necessary, corrections and changes may be required.

Grading policy:

Each project corresponds to 25% of the final grade.

Final grade:  
A = 85-100  
B = 70-85  
C = 55-70

Important notes: The policy of Professor Birman is based on his experience with industry. If a project is not finished or if it contains mistakes, the engineer responsible
for this work is required to correct it and to submit a satisfactory project. Accordingly, if your project is incorrect, we will discuss the source of the mistake and you will have the opportunity to resubmit a correct design. While this may involve an additional effort, this approach usually results a high grade for most of the projects (this is a much nicer outcome than that in industry where if you make too many mistakes, you can find yourself in a less desirable situation looking for another job).

**You have to submit at least three excellent projects to have B for the course. You must submit all four projects with the cumulative grade of 85 or above to have an A.**

**Instructor:**

Professor Victor Birman works in the areas of composite material structures, smart structures, biomechanics, 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, 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 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.

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