VILLANOVA UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT

ME 7502 Spring 2010
Composite Structures Dr. B.J. Sullivan

COURSE OBJECTIVE

The primary objective of this course is to present the analytical methods used to analyze and design structural components fabricated with composite materials. The unique properties of composites and their influence on material and structural design will be emphasized. The course will present both fundamental concepts as well as practical information and methods used on composite materials currently in use in industry.

TENTATIVE COURSE OUTLINE

Lecture	Date	Topic	Supplementary Readings
1	11 Jan	Introduction to Composite Materials and Composite Structures	Jones 1-52
2	TBA	Effective Properties of Particulate Reinforced and Unidirectional Fiber Reinforced Composites; Lamina Stress-Strain Relations	Jones 126-157
3	TBA	Lamination Theory; Laminate Properties	Jones 187-214
4	1 Feb	Laminate Properties (cont'd)	Jones 215-244
5	8 Feb	Laminate Stress Analysis	Jones 245-275
6	15 Feb	Fatigue of Laminated Composites	Jones 333-335; Talrega 1-70
7	22 Feb	Analysis and Design of Composite Beams – Part 1	Vinson 155-214
	1 Mar	MID-TERM EXAMINATION	
8	8 Mar	Analysis and Design of Composite Beams – Part 2	Barbero 231-274
9	15 Mar	Analysis and Design of Composite Plates – Part 1	Whitney 87-176
10	22 Mar	Analysis and Design of Composite Plates – Part 2	Whitney 177-208; Whitney 263-312
11	29 Mar	Analysis and Design of Composite Shells	Vinson 215-258; Barbero 301-320
12	5 Apr	Composite Structural Analysis and Design Issues – Part 1	Jones 372-417; Jones 422-465
13	12 Apr	Composite Structural Analysis and Design Issues – Part 2	Jones 339 – 344
14	19 Apr	Analysis and Design of Adhesively Bonded and Mechanically Fastened Joints	Jones 417-421; Messler 477-508; Vinson 333-360
15	26 Apr	FINAL EXAMINATION	

COURSE CONDUCT

There is no single text book which treats each of the above topics in exactly the same way as they will be covered in this course, or which places the exact same emphasis on the topics as will be placed on them in this course. Consequently, class notes developed by the students from the lectures, supplemented by regularly assigned homework problems, will form the primary source of information. The text book which will be used in the class is

R.M. Jones, Mechanics of Composite Materials, Second Edition, Taylor & Francis, New York, NY, 1999, ISBN 1-56032-712-X.

It is suggested that the students refer to any of the following books for supplementary material:

R.M. Christensen, Mechanics of Composite Materials, Dover Edition, Dover, 2005, ISBN 0-48644-239-X.

J.C. Halpin, Primer on Composite Materials: Analysis, Technomic Publishing Co., Inc., Lancaster, PA, Second Revised Edition, 1992. ISBN 0-87762-754-1.

Structural Analysis of Laminated Anisotropic Plates, J.M. Whitney, Technomic Publishing Co., 1987.

The Behavior of Structures Composed of Composite Materials, J.R. Vinson and R.L. Sierakowski, Martinus Nijoff Publishers, 1987.

Introduction to Composite Materials Design, E.J. Barbero, Taylor & Francis Publishers, 1999.

Joining of Advanced Materials, R.W. Messler, Jr., Butterworth-Heinemann Publishing, Inc., 1993.

Engineered Materials Handbook, Vol. 1: Composites, ASM International, 1987.

M.M. Schwartz, Composite Materials Handbook, McGraw Hill, Second Edition, 1992.

G. Lubin, Editor, Handbook of Composites, Van Nostrand Reinhold Company, 1982.

Aerospace Composites: A Design & Manufacturing Guide, Gardner Publications, Inc., 2008.

R. Talrega, Fatigue of Composite Materials, Technomic Publishing Co. Inc., Lancaster, PA, 1987, ISBN 87762-516-6.

The final course grade will be determined on the following basis:

Homeworks	10%
Course Projects	30%
Mid-Term Examination	30%
Final Examination	30%

INSTRUCTOR AVAILABILITY

The best way to contact me is via email. My e-mail address is brian.sullivan@villanova.edu. I will respond as promptly as possible.

COURSE PROJECTS

Two course projects will be assigned to the students, during this course.

Class Project No.	Description	Due Date	% of Course Project Grade
1	Design of minimum weight composite beam	8 March	50%
2	Fatigue life prediction of composite beam generated in Class Project #1	22 Apr	50%

Complete descriptions of the assigned Class Projects will be provided to the students at a later time.

The preferred file for the submission of the research papers is Microsoft PowerPoint. The format to be used by the students in the preparation of their Class Project report is the following:

- A cover page slide providing the title of the report and the name of the student.
- A brief introductory section providing some background on the nature of the topic.
- A short section describing the objective of the course project.
- A section describing the technical approach used by the student, including key equations. This portion of the report should also describe where the equations were obtained and how they were used in the study.
- A section describing results obtained by the students. The use of graphs and tables, sequentially numbered and containing appropriately descriptive captions, should be freely used in this section.
- A section summarizing the principal conclusions of the research project.
- References used in the performance of the class project can be placed at the end of the report, or can be cited as footnotes and appear at the bottom of selected, specific slides.
- Any other materials deemed sufficiently important to be included in the PowerPoint file, but perhaps too detailed to be included in one of the above sections, should be contained in a Back-Up Slides section of the PowerPoint file. *A perfect example of this is calculations performed by the student, either by hand, Mathcad, Excel, etc. Such calculations should be converted to Adobe Acrobat (i.e., pdf) format and inserted onto the back-up slides.*