VILLANOVA UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT

ME 7502 Fall 2018
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	27 Aug	Introduction to Composite Materials and Composite Structures	Kassapoglou 1-31
2	10 Sep	Effective Properties of Particulate Reinforced and Unidirectional Fiber Reinforced Composites; Lamina Stress-Strain Relations	Kassapoglou 33-39
3	17 Sep	Lamination Theory; Laminate Properties	Kassapoglou 39-53
4	24 Sep	Laminate Properties (cont'd)	Kassapoglou 55-61
5	1 Oct	Laminate Stress Analysis	Kassapoglou 83-113
6	8 Oct	Fatigue of Laminated Composites	Talrega 1-70
	15 Oct	Fall Break – no class	n/a
7	22 Oct	Analysis and Design of Composite Beams	Kassapoglou 179-212
		MID-TERM EXAM electronic distribution	
8	29 Oct	Analysis and Design of Composite Plates – Part 1	Kassapoglou 119-132; Whitney 87-176
9	5 Nov	Analysis and Design of Composite Plates – Part 2	Whitney 177-208; Whitney 263-312; Kassapoglou 145-163
		Electronic & Hard Copy of Mid-Term Exam solutions are due in class at 6:00 pm; Electronic submission of Course Project	
10	12 Nov	Analysis and Design of Composite Shells	Vinson 215-258; Barbero 301-320
11	19 Nov	Analysis and Design of Composite Sandwich and Stiffened Structures	Kassapoglou 259-288
12	26 Nov	Analysis and Design of Adhesively Bonded and Mechanically Fastened Joints	Jones 417-421; Messler 477-508; Vinson 333-360
13	3 Dec	FEA of Composite Structures	Kassapoglou 289-295; Jones 339 – 344
14	10 Dec	Fracture Mechanics of Composite Materials **Course Projects Due; Final Exam Distribution**	Gibson 493-534
15	17 Dec	**FINAL EXAM – Electronic & Hard Copy of Final Exam solutions are due in class at 6:00 pm**	

COURSE CONDUCT

Course Materials

Before and after each class, electronic versions of course materials (i.e., the lecture notes, lecture handouts, current homework assignments, homework solutions and previous quiz solutions) will be available to the students by accessing the website http://vucoe.drbriansullivan.com/me-7502/.

To access videos of the lectures, students should consult the email they received from Victoria Minerva of the College of Engineering Distance Learning Staff at the beginning of the semester.

Homework Assignments

Homework assignments are made for each lecture topic. Both the assignment and the solutions are available on the course website. Homework assignments are neither collected nor graded. To assist the students in keeping up with the course materials, weekly quizzes are given.

Weekly Quizzes

A short, 10-15 minute duration, one question quiz will be given at the start of each class based on the homework assignment. These quizzes are distributed in hard copy form to the in-class students and collected from the in-class students prior to the start of the lecture. The quizzes are distributed electronically to the Distance Learning students and must be completed and returned via email on the evening of each class. Without instructor approval provided on the Friday prior to the Monday due date, and granted only due to special circumstances (e.g., illness), *no late quiz solutions will be accepted*. Electronic submission by in-class students will be accepted only in the event that the in-class student is unable to attend the class in person.

Examinations

All exams are take-home, open book and open notes examinations.

The Mid-Term examination will be provided to the students electronically at least two weeks prior to its due date. The Final Examination will be provided to the students at least one week prior to its due date. Distance Learning students will submit their solutions electronically. In-class students are required to provide exam solutions in hard-copy format and may wish to submit their solutions electronically as well.

Course Text

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 of the lectures, supplemented by handouts and the assigned homework problems, will form the primary source of information. The text book which will be used in the class is the Kassapoglou AIAA text cited below.

C. Kassapoglou, Design and Analysis of Composite Structures with Applications to Aerospace Structures, Copublished by the American Institute of Aeronautics and Astronautics, Inc. and John Wiley & Sons, 2010, ISBN 978-1-60086-780-4.

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

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

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

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

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

R.W. Messler, Jr., Joining of Advanced Materials, 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.

R.F. Gibson, Principles of Composite Material Mechanics, Third Edition, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2012, ISBN 978-1-4398-5005-3.

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

Quizzes	10%
Course Project	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. I can be available to meet with students by an appointment request made in person or submitted via email.

COURSE PROJECT

One course project will be assigned to the students during this course. An example of a course project is provided in the table below.

Class Project No.	Description	Due Date
1	Design of minimum weight composite beam or similar	One week before Final Exam due date

Complete descriptions of the assigned Class Projects will be provided to the students no later than the due date for the Mid-Term Exam solutions.

The preferred file for the submission of the course project 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.*