AEROSPACE
SHORT COURSES

Structural Composites - ONLINE (AERO0495)

Instructor: Max Kismarton, Mark S. Ewing *(This course may be taught by either instructor.)*

Course Description

This course provides an introduction to high-performance composite materials, covering both engineering and manufacturing of composite parts and assemblies, basic material properties of the constituents (fiber and matrix), how they combine to form plies, or lamina, how to obtain lamina properties, how laminae are combined to form laminates and how to obtain the laminate properties. Other engineering topics include stress analysis, failure criteria and testing methods. Case studies and lessons-learned will be discussed. Design using composites will include material selection, lamination rules of thumb, weight analysis, fabrication process description, tool design, and preliminary cost and production rate analysis.

Course Highlights

- Historical review of laminated composite usage
- Constituent materials and properties
- Formulas and analysis tools to predict mechanical properties of laminates
- Introduction to manufacturing composites
- Failure theories and their limitations
- Coupon level testing methods
- Introduction to tooling design
- Design of simple structures and lamination rules of thumb
- Inspection methods
- Bonded and bolted joints
- Hygro-thermal effects
- Interlaminar and free-edge effects
- Durability and environmental issues
- Design problems

Who Should Attend?

The course has proven very helpful to those wanting a broad overview and/or a crash course in composites, experienced engineers looking for a refresher course, stress engineers wanting to understand how composites really work or fail and what to look out for when analyzing parts, data and margins, practicing engineers and managers with metal experience wishing to expand their skill set, anyone wanting to jump into the field but does not know how to go about it, and engineering teams embarking on new projects involving composites.

Learning Objectives

- Examples of high-performance composites used in aircraft
- How to predict laminated composite stiffness and strength properties from properties of the constituent fiber and matrix
- Failure theories for laminated composites
- Design of simple structures with laminated composite materials
- Processes for consolidating laminated composite structures, including tooling
- Inspection processes for composites

Course Outline

- Introduction to composite materials
- Mechanical properties of raw materials
- Mechanical properties of a single ply lamina
- Practice and begin manufacturing plan project
- Ply rotation and transformation
  - Ply formulas for structural coordinates
- Ply level failure modes
- Composites manufacturing methods
- Analysis tools/formulas to predict laminate (stack) elastic properties (classical lamination theory)
- Laminate failure modes
  - Buckling failures
  - Damage tolerance
  - Stack level failure modes and test methods
- Sandwich construction
- Sandwich optimization
- Failure theories
- Structural requirements for aircraft
- Inspecting methods
- Testing methods
- Composites manufacturing cont.
- Lamination rules of thumb
- Manufacturing processes (tools, cure cycles, defects)
- Bonded and bolted joints, how to design and analyze, failure modes
- Tooling design, requirements, features, issues
- Composites manufacturing cont.
- Sandwich inserts, joints, repairs
- Aging of composite structures
- Composite repair
- Cost estimation
- Design problems

Classroom hours / CEUs
35 classroom hours
3.5 CEUs

Certificate Track
Aircraft Structures

Course Materials
Course materials, including outlines, presentation copies, and supplementary materials, will be accessible through Canvas, KU's online learning system. Instructions to access Canvas will be provided upon completed registration.

Course Fees
Early Online Registration fee: $2,195***
Regular Online Registration fee: $2,395
***Early registration fee is available if you register and pay at least 7 days prior to the course start*

Registration is open until the first day of the course; however, early registration is encouraged.

No additional textbook purchases are required outside the course fee. However, it is recommended students purchase the following textbook, which will be useful to utilize during this course: ***Composite Airframe Structures*** by Michael Niu; Hong Kong Conmilit Press Ltd.; Third edition (December 31, 2010) - ISBN-10: 962-7128-06-6 / ISBN-13: 978-962-7128-06-9.

U.S. Federal Employee Discount
This course is available to U.S. federal employees at 10% off the registration fee. To receive the federal employee discount, you must enter the code **FGVT116** during the checkout process. Please note that you must validate your eligibility to receive this discount by entering your U.S. government email address (ending in .gov or .mil) when creating your online registration profile. This discount is available for both the early registration and regular registration fees.

Instructor Bios

Max U. Kismarton is an aircraft designer and a Technical Fellow at The Boeing Company, with extensive hands-on experience in engineering (design, loads, stress, weights, testing, advanced metals and composites), manufacturing (tooling, processes, machinery, shop management) and management (cost engineering and estimating, lean manufacturing, project/program management). He is currently working in the materials and processes group, heading up multiple research and development projects on micromechanical behavior and hybrid laminates, and high performance wing box structures for present and future commercial aircrafts. He has designed and built composite airframe primary structure for small and large composite aircrafts such as Amber, Gnat, High Speed Civil Transport, F-16XL-2, Shadow, ERAST, Hummingbird, UCAV X-45 and the 787 Dreamliner. Kismarton holds a B.S. in aerospace engineering from the University of Kansas.

Mark S. Ewing is former chairman of the aerospace engineering department and is currently the director of the Flight Research Laboratory at the University of Kansas. Previously, he served as a senior research engineer in the structures division at Wright Laboratory, Wright-Patterson Air Force Base, and as an associate professor of engineering mechanics at the U.S. Air Force Academy. His research interests include structural vibrations and structural acoustics, especially as related to fiber-reinforced composites. Ewing is a past recipient of the University of Kansas School of Engineering Outstanding Educator Award. He holds a B.S. in engineering mechanics from the U.S. Air Force Academy, an M.S. in mechanical engineering and a Ph.D. in engineering mechanics, both from Ohio State University.

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CONTACT US:

KU Jayhawk Global
Aerospace Short Course Program
1515 St. Andrews Dr.
Lawrence, KS 66047
Email: jayhawkglobal@ku.edu
Phone: 785-864-6779 (Registration)