Course Title: Advanced Composite Materials and Processes

Course Number: AVT 410-3

Course Date: Fall 2015

Course Location: Room 127 Lecture
Room 105 Lab.

Course Time: Lecture – Thursdays’ 8:00 AM - 9:50 AM
Lab sec 1- Thursday 10:00AM to 11:50AM
Lab sec 2- Tuesday 10:00AM to 11:50AM

Instructor: Keven Mitchell,
Phone 453-9203 cell 618-303-0539
Email mitchell@siu.edu

Office Location Transportation Education Center (TEC), room 226F

Office Hours
Monday & Wednesday 9:00am to 12pm
Other times by appointment or luck.

Course Description: Topics include the theory and application of advanced composite materials used in modern aircraft structures and engine components. Students will evaluate structures and implement various methods of repair and maintenance using both cold and heated application methods.

Prerequisite: AMT 110 or departmental consent.

Learning Outcomes: Identify various defects in advanced composites.

1. Interpret appropriate structural repair manuals used on current Aircraft, Cessna Corvallis and Cirrus SR22 and correctly evaluate damage in regard to reparability.

2. Select the appropriate repair procedure using the appropriate structural repair manual.
3. Select appropriate materials and repair an advanced composite aircraft structure using various industry approved procedures.

4. Correctly set up a vacuum bag, temperature control equipment, and cure a repair using a given cure cycle.

5. Work together as a team to design and build a 1/6th scale composite aircraft within established time periods.

**Instructional Methods:** This course is taught using a variety of instruction including lecture, class discussions, demonstrations, and library and internet research.

**Course Materials:** Safety Glasses, optional light hearing protection


*Textbooks not available at the University Bookstore can be ordered on-line at Half.com, Amazon.com, eCampus.com, bigwords.com, alibris.com, or valorebooks.com, and by special order through Barnes & Noble and most academic bookstores such as 710 Bookstore and Saluki Bookstore.*

**Materials** Instructor developed lecture material, handouts, DVDs and supplemental periodic journal materials.

**Assignment of Course Grade**

The letter grade issued at the completion of the course will be based on the following grading scale:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 90</td>
<td>A</td>
</tr>
<tr>
<td>89 - 80</td>
<td>B</td>
</tr>
<tr>
<td>79 - 70</td>
<td>C</td>
</tr>
<tr>
<td>69 - 60</td>
<td>D</td>
</tr>
<tr>
<td>&lt;60</td>
<td>F</td>
</tr>
</tbody>
</table>

The final grade you receive in this course is calculated based upon your performance in the following four areas:

**Lecture**

Comprises 40% of course grade. Lecture grade is based upon an objective assessment: your performance on 5 periodic written quizzes (25% of total grade) and a Presentation on composites (10% of total grade) and a subjective assessment: class participation (5% of total grade).

**Objective** assessment: written test/quiz questions will require the student to recall facts and solve problems related to advanced composite systems, covered both in readings and in class.
Presentations: Each student will be scheduled for a 15-minute presentation on advanced composites for class presentation.

Subjective assessment: Class participation is based on the instructor’s subjective assessment of the level of the student’s participation in lecture throughout the semester. Factors positively affecting this grade include asking the instructor questions and answering questions posed by the instructor. Factors negatively affecting this grade assessment include the student’s inability to answer questions based on reading assignments or giving the impression that the student is sleeping in class, whether they are or not. Repeated incidents of giving the impression that one is sleeping in class will result in a class participation grade of zero.

Important Note: The lecture portion of the course must be completed with a minimum grade of “D” (60) to receive a passing grade for the AVT 410-3 course.

Laboratory
Comprises 40% of course grade. The lab grade is based on both objective and subjective assessment made by the instructor based upon his observance of the following:

- Timely completion of required lab projects and assignment: Class project if completed prior to the first class returning from the Thanksgiving break will result in no final exam!

- The lab grade has both objective and subjective components, and the number of points earned will be determined by the instructor. Besides timely completion, the number of points awarded for a lab project is a subjective assessment made by the instructor based on the following criteria:
  - Completeness and accuracy of student’s responses to questions about the project’s operation.
  - Care and attention to detail exhibited in lab project assembly, layout and operational testing.
  - Demonstrated actions contributing to the daily maintenance, cleanliness, and security of the lab and the equipment in it.
  - Ability to work well with other individuals in the laboratory.
  - Degree of professionalism demonstrated in laboratory.

Final Exam
Comprises 20% of course grade. Final exam grade is based on your performance on a comprehensive written test covering all aspects of advanced composites systems. Final exam will be scheduled during finals week during normal Lecture class time unless unscheduled circumstances require moving date or time.

AVT 410-3 Testing Guidelines

The following guidelines apply during all lecture and laboratory tests, quizzes and the final
exam. They are also the basis for all work associated with laboratory projects.

**TEST DOCUMENT**

The test document and any additional handouts or scratch paper, regardless of source, is the property of the course instructor. Do not remove the staple from the test.

**ANSWERS**

You must place all of your answers on the test. All answers which require anything more than circling a provided answer must be printed legibly. Cursive (handwriting) will not be accepted and the answer will be marked incorrect.

**SCANTRON ANSWER SHEETS**

Scantron answer sheets may be used. When a Scantron answer sheet is used you must still place all of your answers on the test document. When you have completed the test, transfer your answers for multiple choice and true false questions to the Scantron sheet. Be sure to leave the response on the Scantron sheet blank for any questions that were fill in the blank or required you to provide an illustration on the test document. Be sure to use a number two pencil (which you must supply) and fill in the dot completely.

**CALCULATIONS**

Show all calculations necessary to derive the answer to mathematical questions. Correct answers without necessary calculations will not be accepted. It is your responsibility to bring a calculator to class with you. Calculators cannot be shared or exchanged during a test.

**ROUNDING**

Maintain as many digits of precision as possible (whatever the calculator will carry) while working through the problem. Your final answer should be rounded, as necessary, to the hundredths decimal place, or to the precision required by the question.

**QUESTIONS**

Any questions you may have about a test item should be held until shortly before the end of the testing period. The instructor will let you know when questions may be asked, usually near the end of the testing period.

**PROPERTY**

Do not exchange any materials with any other student during the testing period.

**REMAIN SEATED**

Do not leave your seat unless you have completed the test. If you have a problem such as a broken pencil or dead batteries in your calculator, raise your hand until you draw the instructors’ attention.
Turn in the document and the scantron answer sheet when you finish.

Please maintain silence during the testing period.

No form of academic dishonesty, (see SIU Student Conduct Code, Division IV), will be tolerated.

Attendance
There is a direct correlation between attendance and performance in a course. Students who are absent can expect their performance on projects and tests to suffer.

Absence Definition
Absence will be classified as excused or unexcused. An absence will be classified as excused only if the absence was due to a significant mental or physical problem, or circumstances outside the control of the student. Determination of "significance" or validity of "circumstance" will be made by the instructor, based upon verbal explanation by the student and any pertinent written documentation (i.e. written statement from a medical doctor or psychologist, court document or summons, or military orders). It is the student’s responsibility to provide the instructor with this information prior to the class that will be missed, when possible, or in the case of illness, immediately upon his/her return to class. For consideration as an "excused absence, illness will always require supporting documentation from the SIU Student Health Service or a private physician indicating date and time of appointment.

Any absence which does not meet the preceding criteria for "excused absence" is considered an "unexcused absence". Missed tests can only be made up if the absence is determined to be an excused absence. Unexcused absence missed tests will be assigned a grade of zero.

If you are not present when attendance is taken you will be marked absent. If you arrive late, but less than 10 minutes late, it is your responsibility to approach the instructor upon your arrival or in lecture, at the end of the period to have your "absence" changed to a "late" in the instructor's attendance journal. Failure of the student to approach the instructor upon arrival or at the end of a lecture period will result in the absence as recorded. Two "lates" (less than ten minutes) will count as one unexcused absence, with the accompanying grade reduction.

Safety:

All students must wear Personnel Protection Equipment (PPE) while in labs. Protective glasses will be worn at all times as minimum PPE and a dust mask or respirator will be worn during cutting, sanding and mixing of chemicals. Gloves or protective gels will be used as instructed during labs.

Emergency Procedures:
Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on the BERT’s website at www.bert.siu.edu, Department of Public Safety’s website www.dps.siu.edu (disaster drop down) and in the Emergency Response Guidelines pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. **It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.** The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.

**ADA Statement**

Students with disabilities who may need accommodations, or who have any emergency medical information the instructor should know of, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, no later than the first week of the term. Students also need to contact the SIUC Disabilities Support Services Office in Woody Hall B-150. Call 453-5738

**AVT 410-3 Topical Outline**

The following is the basic outline and addition material will be added during the course. The structure of the course will support Lab assignments and will change accordingly as materials and equipment availabilities vary. Reading assignments will be give at the end of every course, however, if a student wishes to read ahead please see the instructor for advanced planed reading.

**Basic composite information Chapter 1**
- Composites
- Advantages
- Uses
- Awareness and Handling

**Reinforcing Fibers Ch 2**
- Fiberglass
- Aramid
- Carbon/Graphite
- Boron
- Ceramic
- Fiber Usage
- Fiber Placement
Matrix Materials Ch 3
Matrix systems
Thermoplastic
Polyester resin systems
Thermosets
Epoxy resin systems
Chemistry
Mechanics of curing process
Polybutadiene resins
Catalysts
Pre-impregnated materials
Adhesives
Fillers
Metal Matrix

Core Materials Ch 4
Honeycomb
Foams
Styrofoam
Urethane
Poly Vinyl Chloride
Wood cores

Manufacturing Ch 5
Materials
Fabrication Time
Assembly Time
Heat & Pressure
Manufacturing Methods
  Compression Molding
  Vacuum Bagging
  Filament Winding
  Fiber Placement
  Resin Transfer Molding (RTM)
  Pultrusion
  Wet Lay-up
Molds or Tooling
  Plug
  Lay-up
  Mold
  Lay-up
  Splash
Mesh
Painting

**Composite Safety Ch 6**
Material Safety Data Sheets
Personal Safety
  Skin
  Eye
  Respiration
Solvents
  MEK
  Acetone
Use & Storage of Matrix Materials
Fire Hazards
Personal Safety while Machining
Environment

**Applying Pressure Ch 7**
Methods
  Shot Bags
  Clecos
  Spring Clamps
  Vacuum Bagging
Vacuum Bagging Process
  Leak Checks
  Materials
  Films
  Sealant Tapes
  Release Fabrics and Films
  Bleeders
  Breathers
  Calking Plates
  Insulation Layers
  Double Bagging
  Problems

Methods of Curing
  Room Temperature
  Heat Curing
    Step Curing
  Ramp and Soak
Heat Equipment
  Hot Bond
  Heat Blankets
  Heat Guns
  Lamps
  Oven Curing
  Autoclaves
Thermocouples
Recording Units

**Machining Composites Ch 9**
- Cutting Uncured Fabrics
- Machining cured Composites
- Drilling and countersinking
  - Aramid
  - Carbon
  - Glass
- Fasteners
- Dissimilar Electrical Potentials
- Problems
- Materials
- Composite Welding
- Sanding
- Trimming
- Routers
- Drill Bits
  - Diamond cut
  - Herringbone
  - Hole saw Diamond bits
- Water Jets
- Band Saws
- Counter Bores
- Hydraulic Press Cutting
- Laser Cutting

**Setting Up Shop Ch 10**
- Facilities Required
- Storage
- Working environment
- Cost Considerations
- Composite Materials
- Tools & Equipment
- Training

**Assessment and Repair Ch11**
- Classification of Damage
  - Cosmetic Defects
  - Impact Damage
  - Delamination
  - Cracks
  - Hole Damage
- Inspection Methodology
  - Visual Inspection
  - Coin Tap Test
Ultrasonic Inspection (NDI)
Thermography
Laser Holography
Radiography
Hardness Testing
Dye Penetrant

Repair Operations
Traditional Fiberglass Repairs VS Advanced Composite Repairs
Repair Procedures
Evaluate Damage
Surface Preparation
Working Around Aircraft Systems
Removal of Core Damage
Cut and Scarfing
Water Break Test
Preparation
Orientation
Bonding patches
Metal to Metal Bonding
Lighting Protection
Painting
Recording your work
Syllabus Attachment
Fall 2015

http://pvcaa.siu.edu/

IMPORTANT DATES
Semester Class Begins: 08/24/2015
Last day to add a class (without instructor permission): 08/30/2015
Last day to withdraw completely and receive SAUKE CARES: 09/06/2015
Last day to drop a course using SalukiNet: 11/01/2015
Last day to file diploma application (for name to appear in Commencement program): 11/01/2015
Final examinations: 11/12/2015
Veterans Day Holiday: 11/11/2015

WITHDRAWAL POLICY
Students who officially register for a session may not withdraw merely by the stopping of attendance. An official withdrawal form needs to be initialed by the student and processed by the University. For the proper procedures to follow when dropping courses and when withdrawing from the University, please visit http://registrar.siu.edu/pdf/ugradcatalog1314.pdf

INCOMPLETE POLICY
An INC is assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments. An INC must be changed in the student's grade point average. For more information please visit: http://registrar.siu.edu/grades/incomplete.html

REPEAT POLICY
An undergraduate student may, for the purpose of raising a grade, enroll in a course for credit no more than two times (two total) for the same content, subject, and title of the course description. For students receiving a letter grade of A,B,C,D, or F, the course repetition must occur at Southern Illinois University Carbondale. Only the most recent (last) grade will be calculated in the overall GPA and count toward hours earned. See full policy at http://registrar.siu.edu/pdf/ugradcatalog1314.pdf

GRADUATE POLICIES
Graduate policies often vary from Undergraduate policies. To view the applicable policies for graduate students, please visit http://gradschool.siu.edu/about-us/grad-catalog/index.html

DISABILITY POLICY
Disability Support Services provides the required academic and programmatic support services to students with permanent and temporary disabilities. DSS provides centralized coordination and referral services. To utilize DSS services, students must come to the DSS to open cases. The process involves interviews, reviews of students supplied documentation, and completion of Disability Accommodation Agreements. http://disabilityservices.siu.edu/

PLAGIARISM CODE

MORRIS LIBRARY HOURS
http://www.lib.siu.edu/about

FACULTY AND EDUCATION
Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://safe.siu.edu

The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distress—physical, emotional, financial, or personal. By working closely with faculty, staff, students and their families, SIU will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. For more information on Saluki Cares: (618) 453-5714, or siucares@siu.edu, http://salukicares.siu.edu/index.html

Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. We ask that you become familiar with the SIU Emergency Response Plan and Building Emergency Response Team (BERT) programs. Please reference the Building Emergency Response Protocols for Syllabus attachments on the following pages.

Important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.

SIU contains people from all walks of life, from many different cultures and sub-cultures, and representing all strata of society, nationalities, ethnicities, lifestyles, and affiliations. Learning from and working with people who differ is an important part of education as well as an essential preparation for any career. For more information please visit: http://www.inclusiveexcellence.siu.edu/

HELP
Learning support services offers free tutoring on campus and in the community. To find more information please visit the Center for Learning and Support Services website:

Tutoring: http://tutoring.siu.edu/
Math Labs: http://tutoring.siu.edu/math_tutoring/index.html

The Writing Center offers free tutoring services to all SIU students and faculty. To find a Center or Schedule an appointment please visit http://write.siu.edu/

Additional Resources Available:
SALUKINET: https://salukinet.siu.edu/cp/home/displaylogin
ADVISEMENT: http://advisement.siu.edu/
SIU ONLINE: http://online.siu.edu/