Self-paced Online CMfgT and CSET Courses for Practicing Professionals and Engineering Graduates

Presented by:

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JAMS Technical Review

September 23, 2021

Federal Aviation Administration

Joint Centers of Excellence for Advanced Materials

A Center of Excellence AMTAS Advanced Materials in Transport Aircraft Structures

CECAM center of excellence for composites and advanced materials

Introduction

- Project Title : FAA CSET, CMT, CMfgT and Adhesive Online Courses –Modifications and Implementation
- Project Participants
  - Suresh Keshavanarayana (P.I)
  - Carolyn Speer, Taylor Moore, Wuhib Frehiwot (Office of Instructional Resources)
- FAA Technical Monitor
  - Cindy Ashforth, Allan Abramowitz, Ahmet Oztekin
- Other FAA Personnel
  - Larry Ilcewicz, Charlie Seaton

Background

- **Motivation and Key Issues**
  - Provide online educational options for practicing professionals and engineering graduates
    - Composite Manufacturing Technology Safety Awareness (CMfgT)
    - Composite Structural Engineering Technology (CSET)
  - Offer online courses on a flexible schedule without minimum enrollment constraints
    - CMfgT (~ 4 +1 weeks; asynchronous online)
    - CSET (~ 12 weeks; 6 + 6 weeks (2020); asynchronous online)
    - Minimum enrollment required ~ 15
  - Turn key option for industries/agencies seeking workforce training

Background..WSU Badge Courses

•Source : http://badges.wichita.edu/node/87, ***Frequently Asked Questions for Faculty– Badge Development and Instruction***

What is a Badge?

"Badges are short credit (0.5, 1.0) courses that appear on a transcript indicating that academic work was successfully completed in a short course. Badges are designed for working, non-degree seeking professionals. Badges may also be granted for successful completion of workforce related noncredit academic programs."

Can badges be offered for academic credit?

"Yes. Badges can be awarded for approved undergraduate or graduate level academic work completed in workshops and short courses, in which there may be a need or it may be useful to award credit for less than a full credit hour. Badges for academic credit must meet the University's definition and assignment of credit hours and have measureable learning outcomes."

Background..WSU Badge Courses

WICHITA STATE UNIVERSITY

•Source : http://badges.wichita.edu , ***Frequently Asked Questions for Faculty– Badge Development and Instruction***

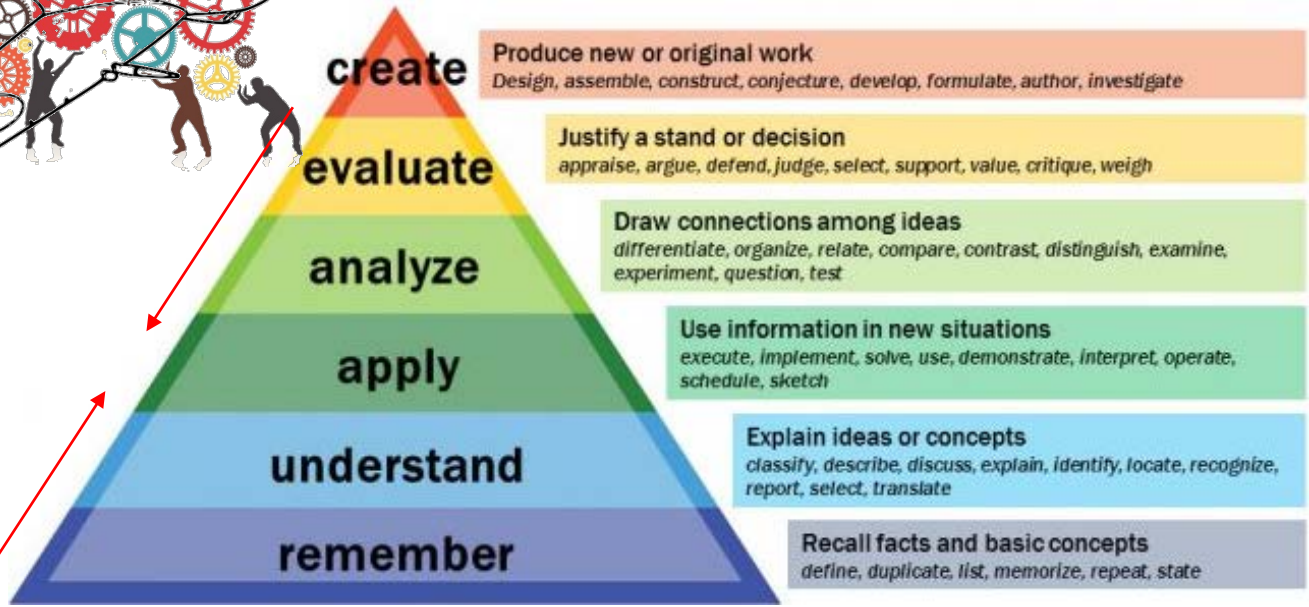
•Do badges count toward a degree or certificate?

Badge credit hours may apply to a university degree, if the student has been or is admitted as a degree seeking student into a degree program (pursuant to all policies governing such admission, including qualified admissions requirements) and the academic unit accepts the credit hours as part of the degree program. Badges may be “stacked” to allow professionals to gain a certificate to document their learning. This would allow both the University and the employer to document the quality of the student learning in a manner that is much more rigorous than traditional noncredit continuing education offered by most universities. Because these courses would all meet HLC standards, faculty and departments may choose to allow these courses to count toward a university degree should the student later be admitted to a degree program.

•Who is qualified to teach a badge course?

Instructors must meet Higher Learning Commission credentialing polices, which includes possessing an academic degree relevant to what they are teaching and at least one level above the level at which they teach, except in programs for terminal degrees or when equivalent experience is established.

Background: Student types/Audience



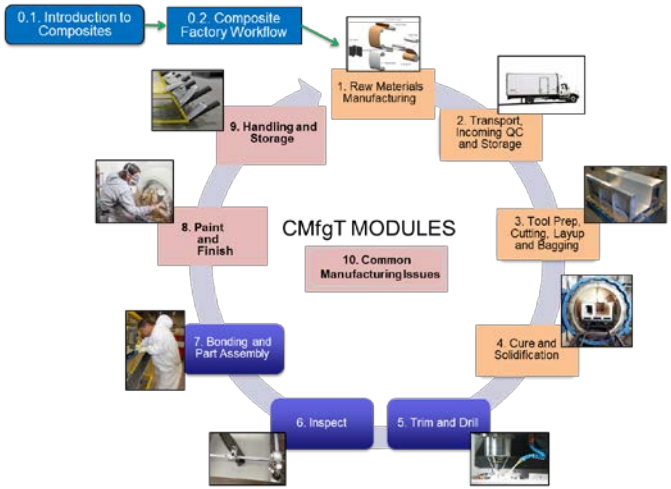
Armstrong, P. (2010). Bloom's Taxonomy. Vanderbilt University Center for Teaching. Retrieved [9/15/2021] from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Background

- **Objective and Scope**
  - **Modularize the CMfgT and CSET courses and incorporate them into the WSU curriculum**
    - Accommodate both *non-degree* seeking and *degree* seeking students
      - **Badges**, Certificates, Special Topics courses
  - **Perennially offer CMfgT and CSET courses in a flexible format**
    - Make courses available throughout the year (Spring, Summer & Fall)
    - Options to complete the course in a single semester or spread out over multiple semesters
    - Course credits *stackable* for earning Certificates and towards M.S. & Ph.D degree requirements

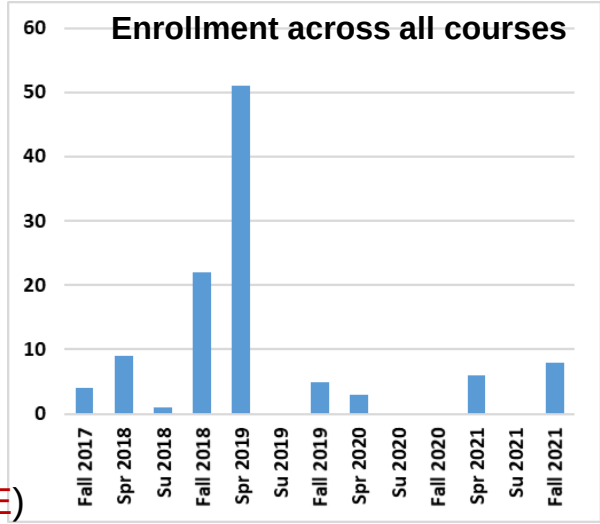
Previous Work

- Phase-I : Composites Manufacturing Technology (CMfgT) Safety awareness courses modularized and offered for both degree seeking graduate students and non-degree seeking practicing professionals
  - Course content developed by Convergent Manufacturing Technologies under FAA grant 8-C-AM-WISU
  - Previously offered as a 4+1 weeks of “continuing education” course.

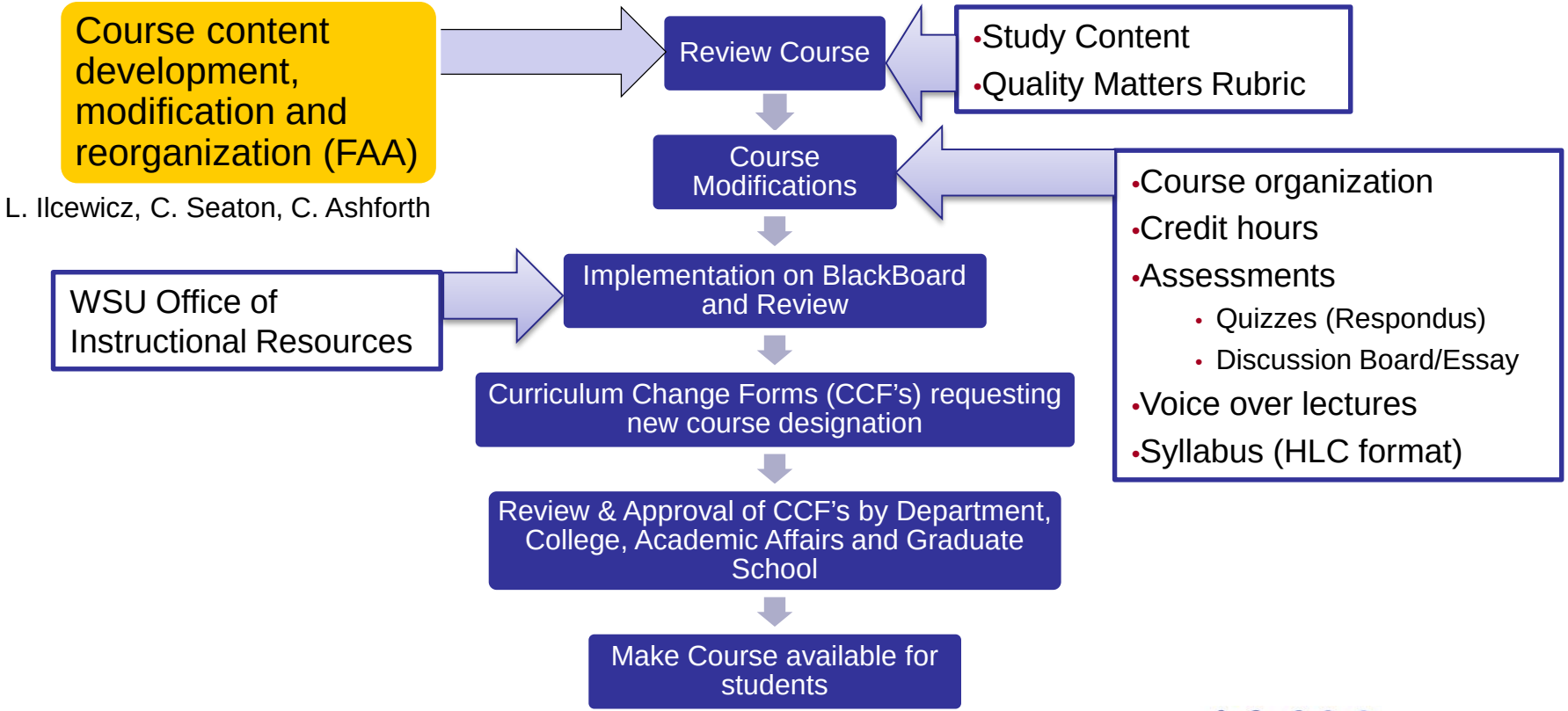


Since Fall 2017, both “badge” and Graduate credit courses (0.5 cr. hrs) have been offered through WSU

- CMfgT-I (AE 770BA/ AE 765A)
- CMfgT-II (AE 770BB/ AE 765B)
- CMfgT-III (AE 770BC/ AE 765C)
- CMfgT-IV (AE 770BD/ AE 765D)
- CMfgT-V lab (AE 770BE/ AE 765E)



Current Work : CSET Course Modification & Implementation



CSET : Syllabus Document ..sample

WICHITA STATE UNIVERSITY

AE 765G: Composites Structural Engineering Technology-1, Fall, 2021

- Instructor: S. Keshavanarayana
- Department: Aerospace Engineering
- Office Location: 227E Wallace Hall
- Telephone: 316-978-5939
- Email: suresh.keshavanarayana@wichita.edu
- Preferred Method of Contact: e-mail/Discussion Board
- Office Hours: 1:00 PM to 2:30 PM, MW
- Classroom Day/Time: Online
- Prerequisites: AE 765F

How to use this syllabus

This syllabus provides you with information specific to this course, and it also provides information about important university policies. This document should be viewed as a course overview; it is not a contract and is subject to change as the semester evolves.

Academic Integrity

Students at Wichita State University are expected to uphold high academic standards. WSU will not tolerate a lack of academic integrity. Students are responsible for knowing and following the Student Code of Conduct http://webs.wichita.edu/inaudit/ch8_05.htm and the Student Academic Honesty policy http://webs.wichita.edu/inaudit/ch2_17.htm. When the faculty member determines sanctions are warranted for violations of academic integrity, regardless of severity, the faculty member must report the infraction to the Office of Student Conduct and Community Standards. If you need more information about the process or wish to appeal a decision, please visit https://www.wichita.edu/about/student_conduct/AcademicDishonesty.php.

Course Description

AE 765G Composite Structural Engineering Technology-1 (0.5 cr): This course provides an historical overview of composites usage in aircraft structures; discusses the key technical characteristics of composite structures; composites safety and certification initiatives by FAA; issues affecting cost of incorporating composites; role of standards organizations; some evolving composite technologies; evolution and objectives of integrated product teams.

Definition of a Credit Hour

Success in this 0.5 credit hour course is based on the expectation that students will spend, for each unit of credit, a minimum of 48 hours over the length of the course for instruction and preparation/studying or course related activities for a total of **24** hours.

Measurable Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- List/Describe the course objectives which include principles of substantiating composite airframe structures during certification
- Provide examples of composite applications
- List/Describe the key technical characteristics of composite airframe structures
- List/Describe composite safety and certification initiatives by the FAA relating to composite technology
- Explain various issues affecting the cost of incorporating composites into aircraft design and technology options
- Describe the role of standards organizations, and how the lack of composite standardization practices has resulted in a wide range of approaches in aircraft composite structural design and certification
- Explain what factors have led to a lack of trained composite resources, including initiatives to improve composite knowledge in the workforce
- Describe evolving composite technologies
- Describe how product decisions are affected by composite development and recurring cost structure, and how this might affect the integration of composite technology into new aircraft
- Describe two case studies for illustration of product decisions related to aerospace cost structure, with emphasis on composite technology
- Identify benefits of concurrent engineering and historical evolution of the IPT concept
- Describe various objectives of IPT during the design

CSET : Syllabus Document ..sample

- Describe the disciplines, including responsibilities and knowledge within those disciplines, that comprise an Integrated Product Team (IPT)

Required Texts/Readings Textbook

Soft copies (pdf) of course notes will be provided.

Other Equipment/Materials

Online students are required to have complete access to a functioning laptop or PC with internet capabilities. This laptop or computer must have Microsoft Word. If you do not have Microsoft Word on your PC or Laptop, Wichita State does provide free access to Microsoft Office 365 for students. Follow the instructions below to get Microsoft Office:

1. Log in to MyWSU
2. Click on Office 365 located on the "Home" tab
3. Follow the Office 365 wizard instructions

Before you begin your coursework, ensure that your computer meets technical standards (software, computer equipment, general skills, program management skills, communication skills, and managing your WSU e-mail) for use in online courses.

Class Protocol

Though this is an online class, participation is still crucial. "Participation" involves reading the assignments thoroughly, reading any handouts provided for the week, watching all videos (including update videos I add throughout the semester), contributing to class discussions, and completing online assignments. To be successful in this class, you should be checking your student email daily and logging in to our course at least 3 times a week.

Contact Policy

Although you may attempt to reach me by phone, email communication is always preferred. Feel free to email me any questions or concerns following these guidelines:

- Always use the course name in the subject line of the email
- Remember to sign your name.
- **Always** email me from your WSU email address. Email sent from personal email servers like Gmail, Yahoo, etc., have a tendency to end up in my spam folder, and I never see them. You may also email me through Blackboard via the Email My Instructor tab. I also offer an Ask My Instructor forum on Blackboard which allows common questions to be seen and responded to publicly.
- You should NOT contact me for tech support.
    - Any technical problems involving your computer, or issues regarding file uploading or sharing, should go through the OneStop. You can contact them at 316-978-3909. You can also fill out a request for help form at their website.
    - However, if you have a problem with access or uploading assignments, you *should* let me know before your assignment is due. You will also have to accompany this notification with the file in question, so I can verify that it is completed by the due date/time.

Response Time

To Email and Ask My Instructor Questions: Within 24 hrs during weekdays only.

Feedback on Assignments: Within 48 hrs during weekdays only.

Grading Scale

WSU uses a +/- grading scale for final grades and to calculate grade point averages. In this class, grades are assigned according to the following chart. (Other classes might assign grades differently: Be sure to understand the different grading scales in all of your classes.)

Points/Percentage	Letter Grade	Grade Points	Interpretation
S ≥ 85	S	n/a	Completed requirements for course
S < 85	NS	n/a	Did not complete requirements for course

Assignments

The following assignments must be completed to progress through the course.

Activity	% of final grade
Online Quiz 01	15%
Online Quiz 02	30%
Online Quiz 03	30%
Discussion Board activity	25%

CSET : Syllabus Document ..sample

Course Schedule: This online course is intended for learning on a flexible schedule. The course may be completed over twelve days or earlier per the schedule listed below. The course activities must be completed before the semester end date.

Week	Day	Topics, Readings, Assignments, Deadlines
1	1,2	• Introduce yourself on Discussion Board • Review Course notes/watch lecture video of Chapter 1: **Introduction to Composite Materials as applied to Aircraft Structures** • Complete Online Quiz 01 with a score of 85% or higher
1	3,4	• Read Course notes / watch lecture video of Chapter 2: **Challenges** • Complete Online Quiz 02 with a score of 85% or higher
1	5	• Read Course notes / watch lecture video of Chapter 3: **Integrated Product Development Teams** • Complete Online Quiz 03 with a score of 85% or higher
1	6	• Review and Discussion Board activity

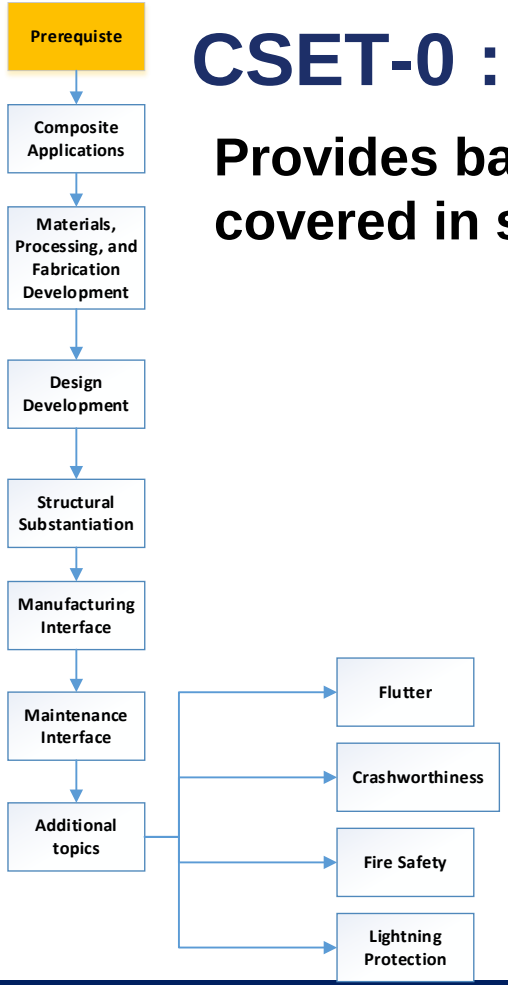
Updated for accessibility on October 11, 2017 from content that was updated on August 13th, 2017

CSET Badge & Graduate Credit Courses

Course No.	Credit Hrs	Topics
AE 770BG / AE 765F	0.5	CSET 0: Prerequisites
AE 770BI / AE 765G	0.5	CSET 1: Composite Applications
AE 770BJ / AE 765I	1.0	CSET 2: Materials, Processing, and Fabrication Development
AE 770BK / AE 765J	1.0	CSET 3: Design Development
AE 770BM / AE 765K	1.0	CSET 4: Structural Substantiation
AE 770BN / AE 765M	0.5	CSET 5: Manufacturing and Maintenance Interface
AE 770BO / AE 765N	0.5	CSET 6: Flutter, Crashworthiness, Lightening Protection, Fire Safety

Available beginning Fall 2021

CSET-0 : Prerequisite Course (0.5 cr.hrs)



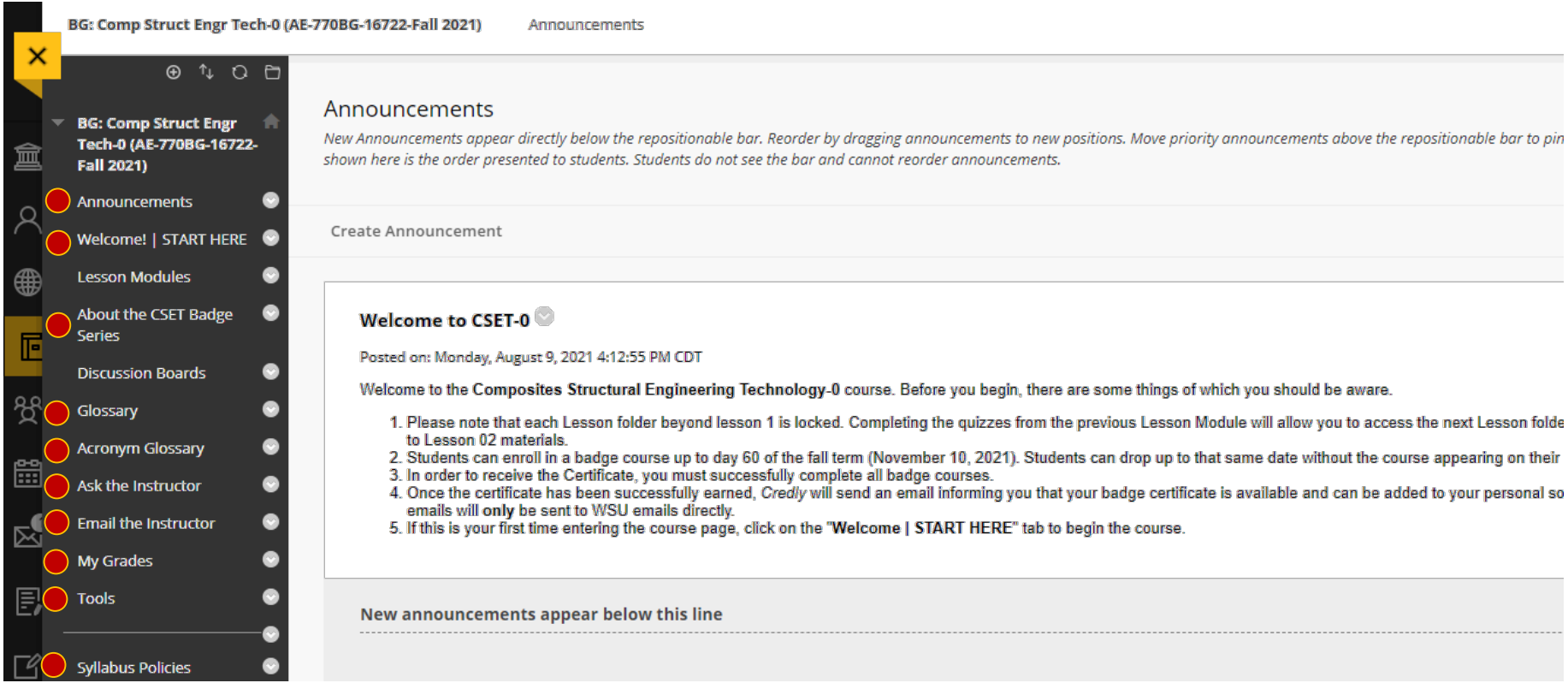
Provides background information about the topics to be covered in subsequent courses.

0.1 Introduction to Composite Materials as applied to aircraft structures
0.2 Materials, Processes, and Manufacturing
0.3 Structural Design
0.4 Proof of Structures
0.5 Maintenance
0.6 Considerations such as aeroelastic issues (e.g., flutter), crashworthiness, fire safety, and lightning protection

- Students review “self-study” course materials/notes
- Assessment using quizzes (x 6)

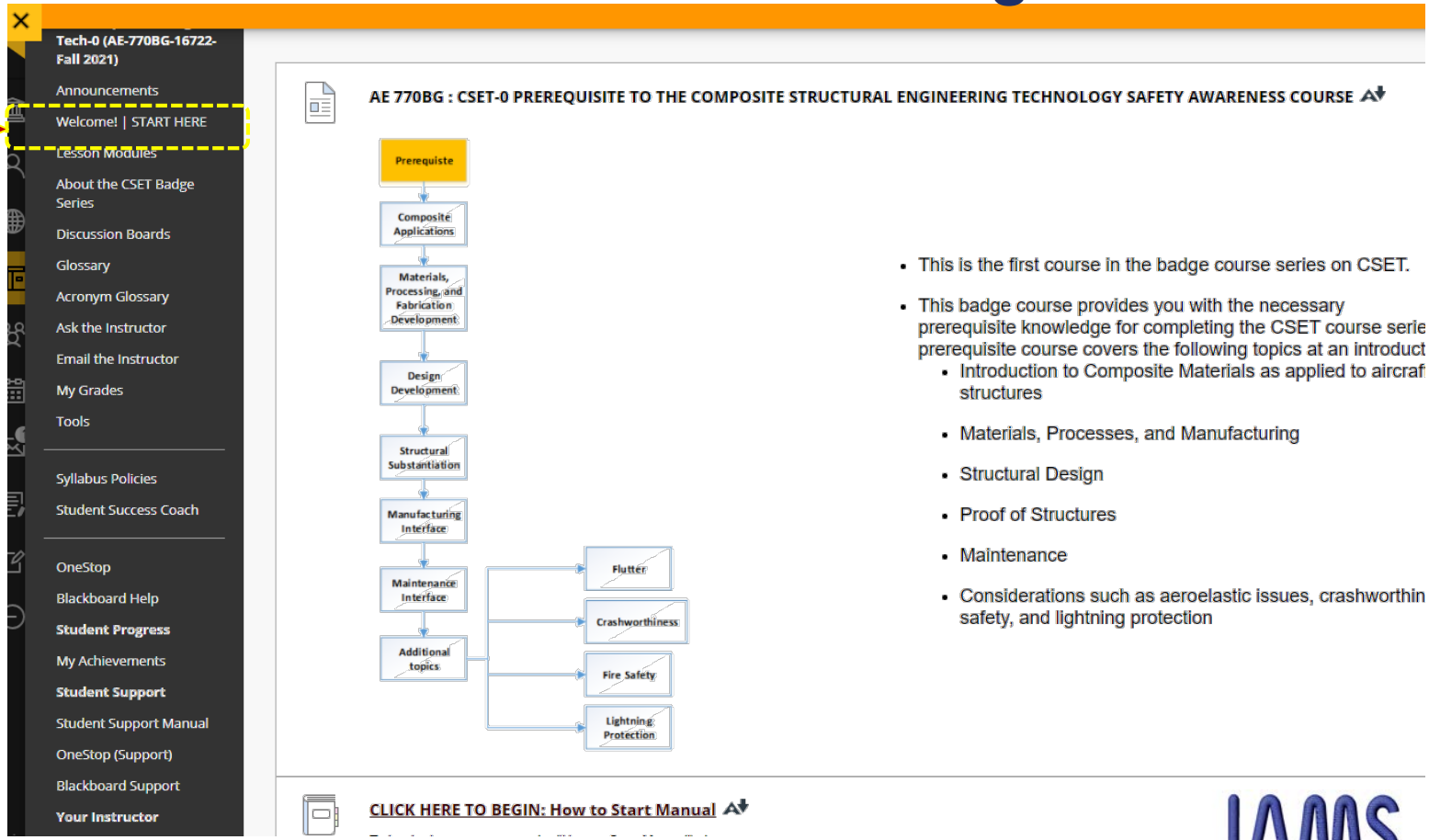
Note : This course combined with all the CMfgT courses satisfies a 3 credit hour “special topics” course option for graduate students. The “special topics” courses may also be used to satisy requirements for the Advanced Composites Certificate

CSET-0 BlackBoard Course Page

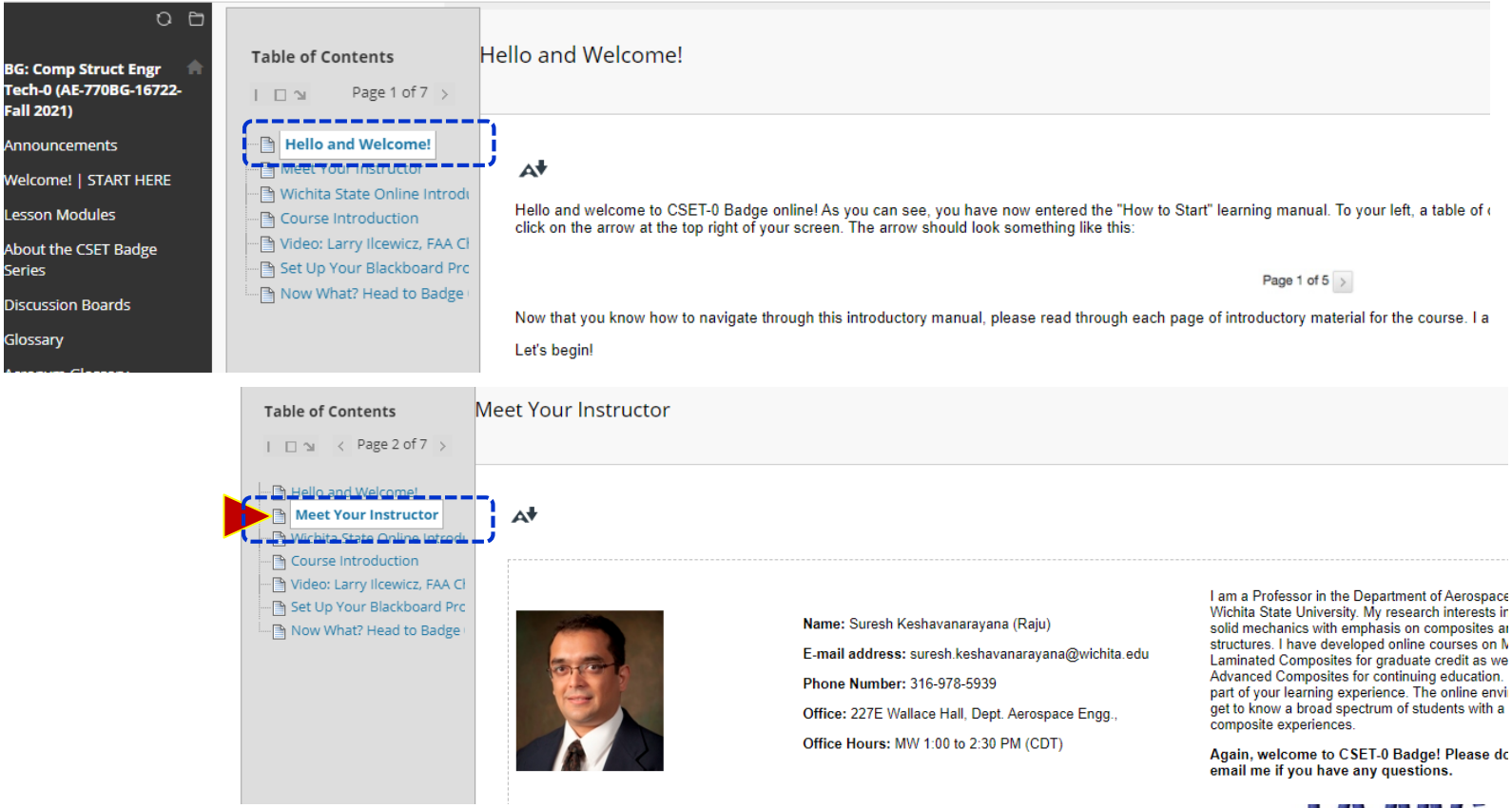


Common to all badge/graduate credit courses courses

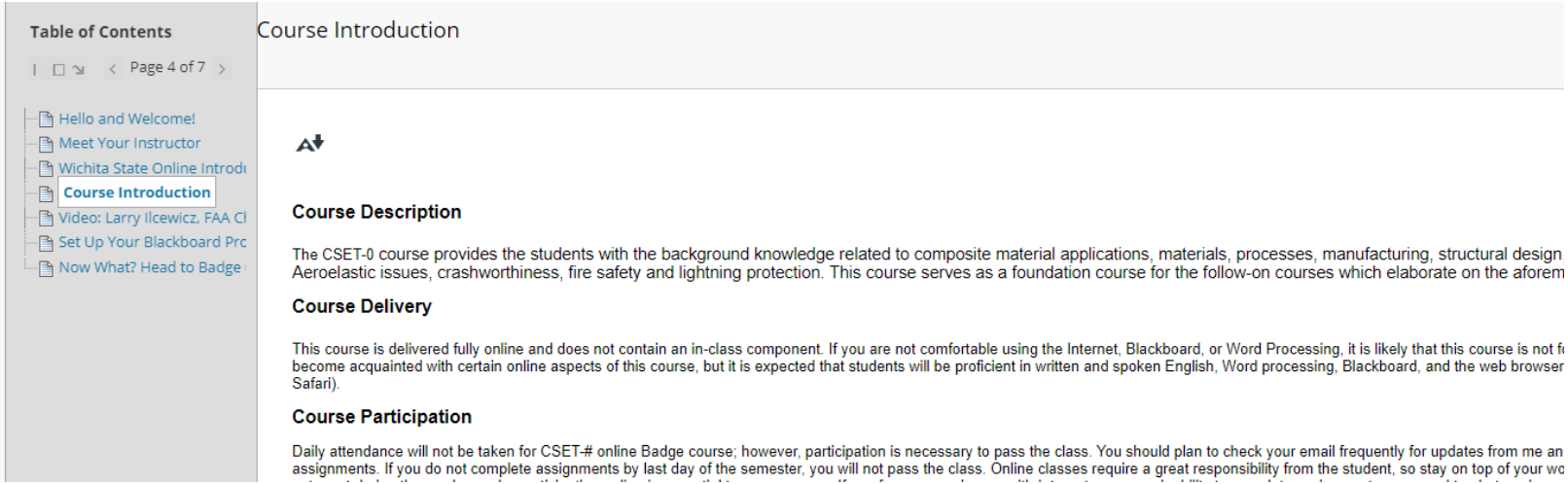
CSET-0 BlackBoard Course Pages..

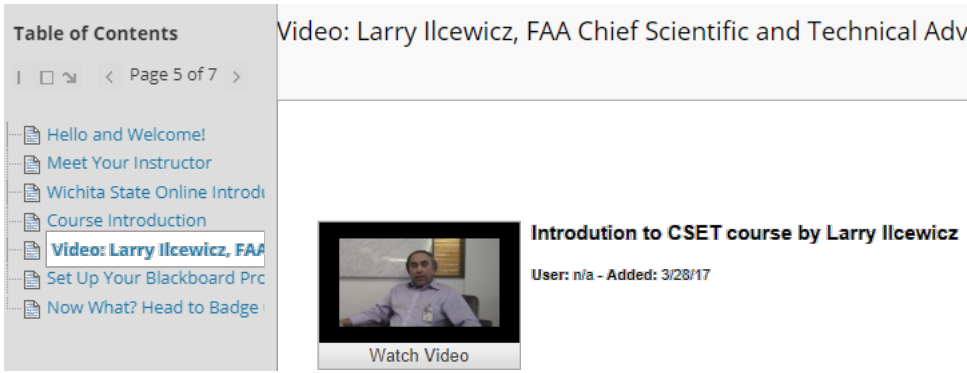


CSET-0 BlackBoard Course Pages..



CSET-0 BlackBoard Course Pages..





CSET-0 BlackBoard Course Pages.. Lesson Modules

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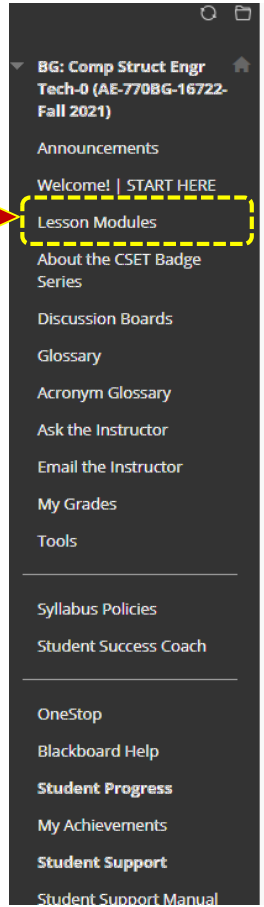


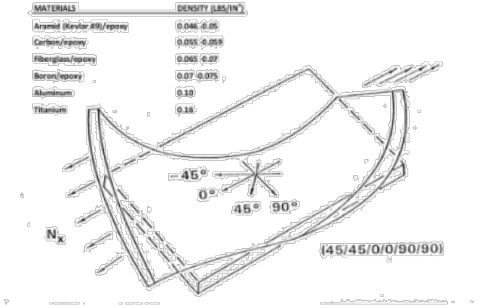
Lesson Modules

Introduction to Composite Materials as applied to Aircraft Structures

Click the title above to access materials

Topics covered in this lesson are

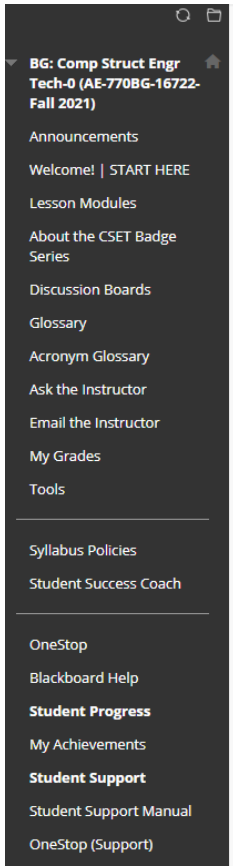
- Characteristics of Typical Composite Materials
- Composite Applications to Aircraft Structures
- Composites versus Metals
- Regulations, Guidance, and Information sources



Materials, Processes, and Manufacturing

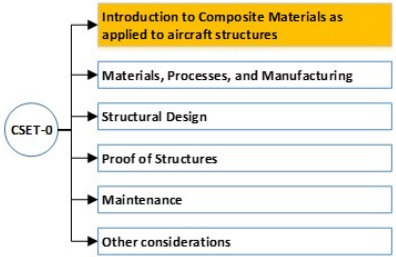
Click the title above to access materials

CSET-0 BlackBoard Course Pages.. Lesson Modules



Introduction to Composite Materials as applied to Aircraft Structures

Instructions



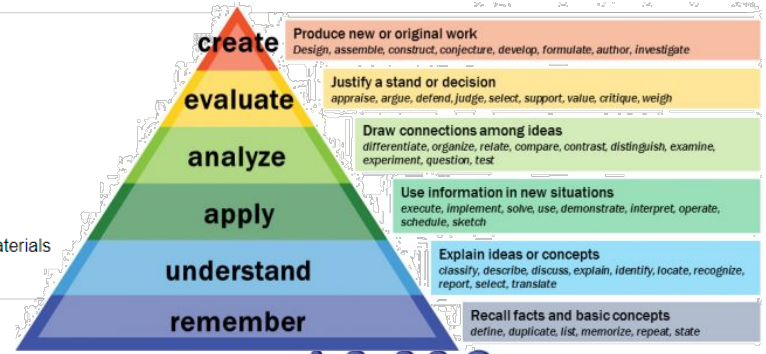
1. Download the course notes in pdf format (click on the link below) and have a printed copy handy.
2. Review the materials.
3. After reviewing the chapter, you must attempt Quiz 01.
4. Successful completion of Quiz 01 at 85% or above will allow you to move on to the subsequent chapter.

The course notes was developed by FAA. The design of the online instruction was done by Instructional Design and Technology, Wichita State University.

Lesson Objectives

At the end of this course module, you should be able to:

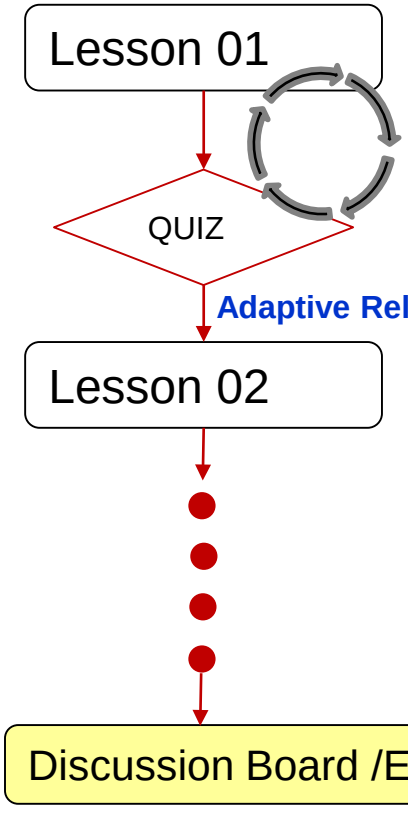
- Describe/define/list the constituents and characteristics of composite materials
- List/recognize the differences between composites and metals
- Describe/list/recognize the manufacturing and design options for composites.
- List/recognize the regulations, guidance, and information sources for composite materials



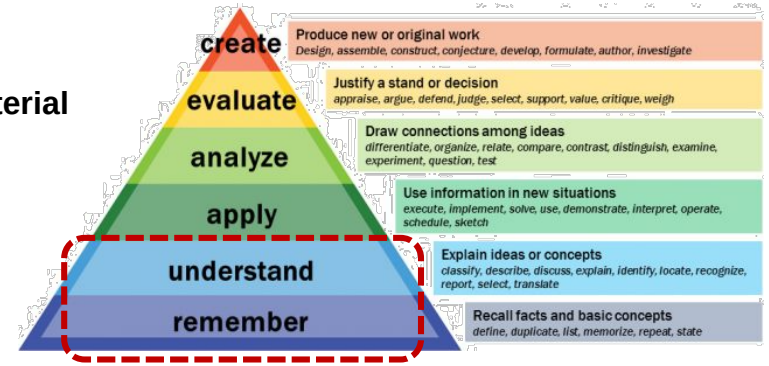
Chapter 1 (Click to open in a new tab)

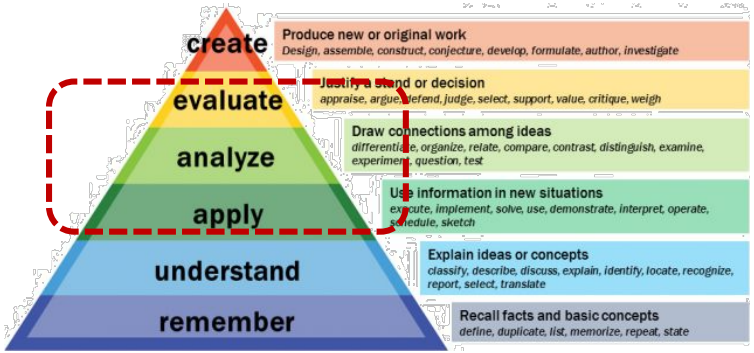
Armstrong, P. (2010). Bloom's Taxonomy. Vanderbilt University Center for Teaching. Retrieved [9/15/2021] from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Learning Approach



- **Enforces review of course material**
- **Provides focus**

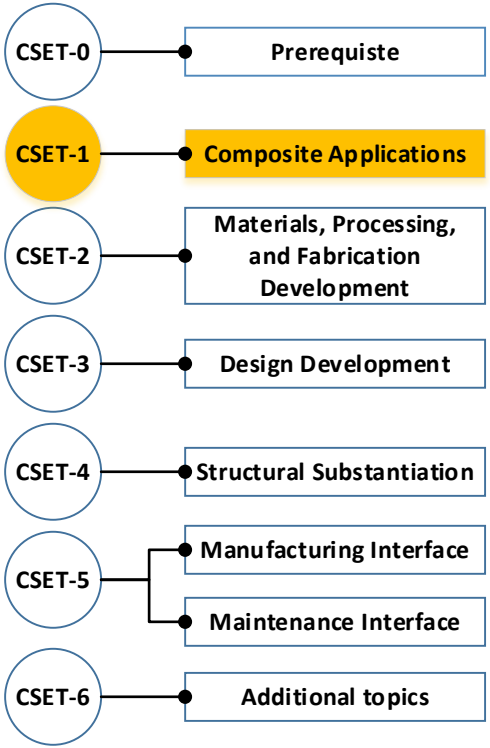




Is the student able to apply what has been learnt ?

Armstrong, P. (2010). Bloom's Taxonomy. Vanderbilt University Center for Teaching. Retrieved [9/15/2021] from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

CSET-1 : Composite Applications (0.5 cr.hrs)



This course provides an historical overview of composites usage in aircraft structures; discusses the key technical characteristics of composite structures; composites safety and certification initiatives by FAA; issues affecting cost of incorporating composites; role of standards organizations; some evolving composite technologies; evolution and objectives of integrated product teams. The individual learning modules within this course are as follows.

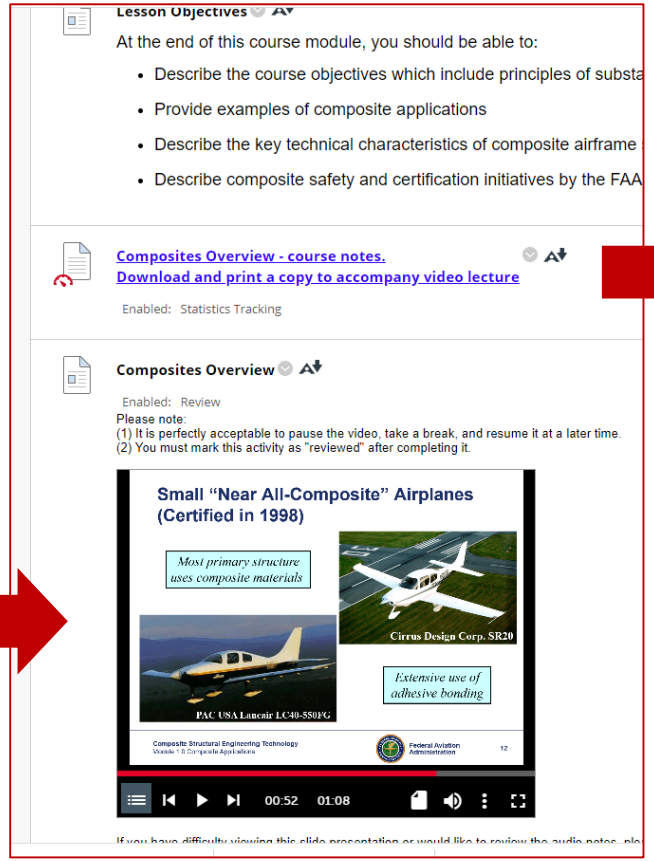
1. Composites Overview
2. Challenges
3. Integrated Product Development Teams

- Students review “self-study” course materials/notes
- Students watch voice over lecture videos with embedded quizzes
- Assessment using quizzes (x 3) + Discussion Board Activity (x1)

Lecture videos and course Notes

Wichita State University

Voice over lecture videos



Power point slide

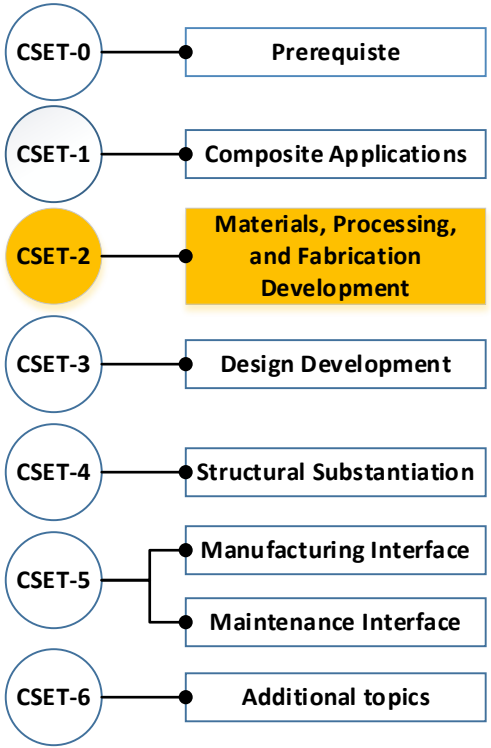
Power point author notes and space for student notes

The Composite Structural Engineering Technology (CSET) course was developed to provide a complete overview of the structural engineering technology important to composite applications in critical structures of aircraft products. According to the Advisory Circular 20-107B, a critical structure is a load bearing structure or element whose integrity is essential in maintaining the overall flight safety of the aircraft. This definition was adopted for AC 20-107B because there are differences in the definitions of primary structure, secondary structure, and principle structural elements or PSE's when considering the different categories of aircraft. For example, PSE are critical structures for Transport Category Aircraft.

Although this goal associates with the overall safety of load-bearing structures, there will be some parts of the course that cover other engineering details important to composite safety and certification. For example, the module on fire safety covers the expectations for certification of interior structures, which may not be directly linked to any structural capabilities.

[1] The intent of CSET was to provide a balanced coverage of the technical issues, certification guidance and typical engineering practices that have been used in support of composite structural aspects of certification.

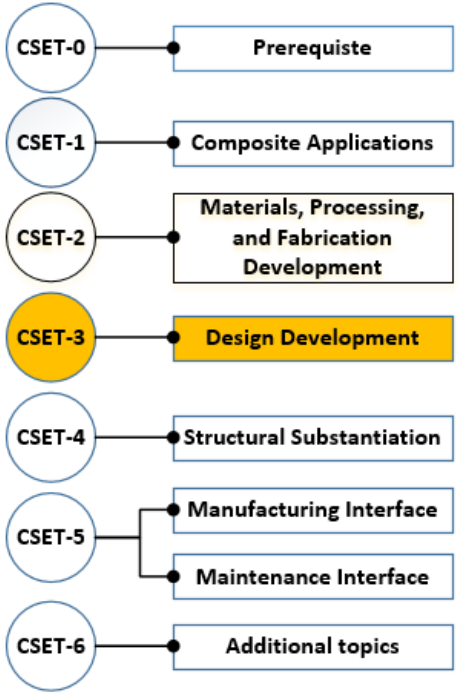
CSET-2 : Materials, Processing and Fabrication Development (1 cr.hr)



1. Material and Process Control
   a) Regulations
   b) Technical Challenges
   c) Stable Materials
   d) Material Specification
   e) Manufacturing Control
   f) Qualification Testing
   g) Roles & Responsibilities
2. Damage and Defects
3. Protection of Structure
4. Manufacturing Implementation
5. Maintenance Implementation

- Students review “self-study” course materials/notes
- Students watch voice over lecture videos with embedded quizzes
- Assessment using quizzes (x 11) + Discussion Board Activity (x1)

CSET-3 : Design Development (1 cr.hr)



3.1 Structural Design Details

3.2 Design Considerations for Manufacturing and Maintenance

3.3 Other Design Considerations

3.4 Design Requirements, Criteria and Objectives

3.5 Lamination Theory and Design

3.6 Composite Analysis Methods

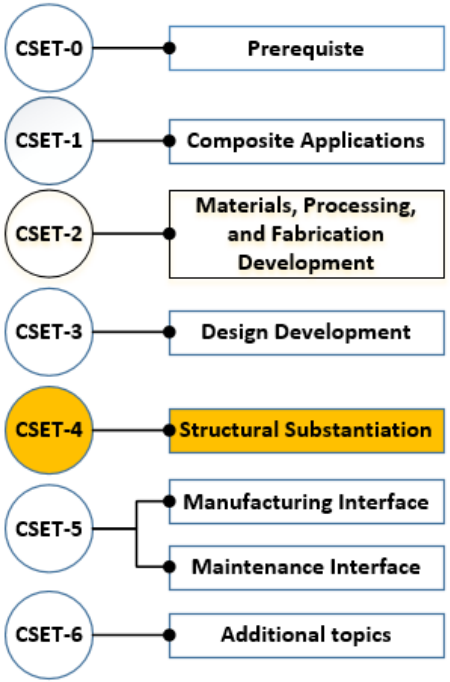
3.7 Composite Material Allowables, Design Values and Knockdown Factors

3.8 Structural Bonding

3.9 Structural Bolted Joints

- Students review “self-study” course materials/notes
- Assessment using quizzes (x 9) + Discussion Board Activity (x1)

CSET-4 : Structural Substantiation (1 cr.hr)



4.1 Regulations and Guidance for Proof of Structures

4.2 Certification Approaches and Related Considerations

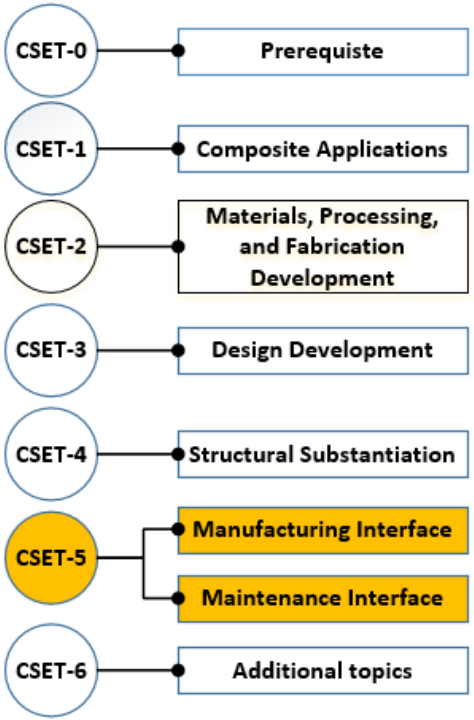
4.3 Addressing Damage and Defects

4.4 Building Block Testing and Analysis

4.5 Additional Considerations for Large Scale Testing

- Students review “self-study” course materials/notes
- Assessment using quizzes (x 8) + Discussion Board Activity (x1)

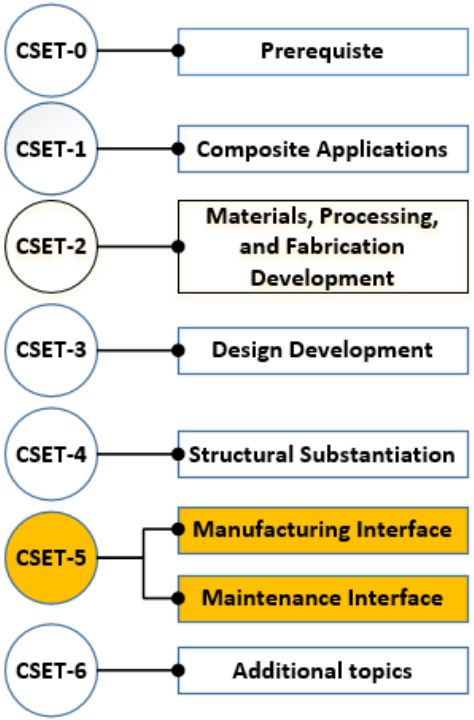
CSET-5 : Manufacturing Interface & Maintenance Interface (0.5 cr.hrs)



1. Quality Control
2. Certification Conformity Process
3. Manufacturing Defect Disposition
4. Inspection and Maintenance
5. Structural Repair Development and Substantiation
6. Teamwork
7. Repair Techniques

- Students review “self-study” course materials/notes
- Assessment using quizzes (x 7) + Discussion Board Activity (x2)

CSET-6: Additional Topics (0.5 cr.hrs)



1. Flutter
2. Crashworthiness
3. Fire Safety
4. Lightning Protection

- Students review “self-study” course materials/notes
- Students watch voice over lecture videos
- Assessment using quizzes (x 4) + Discussion Board Activity (x1)

Status and Next Steps

- **CMfgT & CSET Badge+Graduate course development completed**
- **Courses will be offered per WSU academic calendar (beginning Fall 2021)**
- **Final report preparation (Due 11/30/21)**
  - Focus on implementation into WSU curriculum
  - Assessments
- **CSET/CMfgT lab offerings (1st week of May & October)**
  - Promote graduate student enrollment