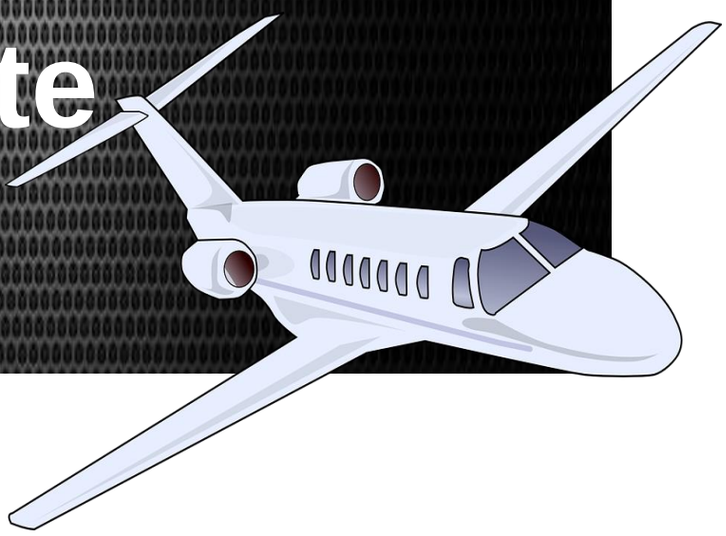
AMT 2106 –AIRCRAFT MATERIALS CONSTRUCTION AND REPAIR II
(Composite)

PRELIM PERIOD

MODULE I

Introduction to Advance Composite



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AMT Instructor

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REFERENCES	Ref no.
Tri-Dung Ngo(2020) ; Composite and Nano composite Materials-from Knowledge to Industrial applications retrieved to https://www.intechopen.com/books/composite-and-nanocomposite-materials-from-knowledge-to-industrial-applications/introduction-to-composite-materials	**1**
A&P Technician Airframe Textbook - Jeppesen	**2**
Air Transport Association (ATA 100 Numbering System)	**3**
Federal Aviation Administration. Advisory Circular .FAA AC.43-214(2013) citation: Repairs and Alterations to Composite and Bonded Aircraft Structure	**4**
Head, School of Materials Science and Engineering (2013) retrieved to http://www.materials.unsw.edu.au/	**5**

This module briefly discusses the overview in composite in application to structures of an aircraft. This module also addresses the advantages of fibre composite materials as well as fundamental effects, product development, and applications of fibre composites, including material chemistry, designing, manufacturing, properties, and utilisation of the materials in various applications. It also emphasized the terms and definitios as well as the abbreviation and ATA chapter related to composite.

The Module I also discusses the elements of composite and give a specific difenition that everyone can understand easily.

TIMEFRAME

You should be able to complete this module including all the self-assessments, research works, assignments, and other performance tasks within **3** hours.

LEARNING OUTCOMES

Course Learning Outcomes (CLO)

CLO 1. Understand the development of the composite structure and classify its element in terms of properties , advantages and characteristics of each elements.

CLO8. Sharpen the ability of the student to share and integrate their ideas in a group work regarding the methods and techniques in machining or development of the composite structure .

CLO 9. Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria, methods and techniques.

Module Learning Outcome (MLO)

MLO 1. Exhibit memory of previously learned material by recalling facts, terms, basic concepts of composite structures, such as terms and definitions that are important in this course, and the advantages and disadvantages of using composite in application to the aircraft.

MLO 2. Define the differences between the matrix and reinforcing material as elements of composite

Topic Learning Outcomes(TLO)

TLO 1. Discussion by recalling facts, basic concepts of composite structures, such as terms and definitions that are important in this course , and the advantages and disadvantages of using composite in application to the aircraft.

TLO 2. Discussion by defining the differences between the matrix and reinforcing material as elements of composite

MODULE I: INTRODUCTION TO COMPOSITE

Composite materials have played an important role throughout human history, from housing early civilizations to enabling future innovations. Composites offer many benefits; the key among them are corrosion resistance, design flexibility, durability, light weight, and strength. Composites have permeated our everyday lives such as products that are used in constructions, medical applications, oil and gas, transportation, sports, aerospace, and many more. Some applications, such as rocket ships, probably would not get off the ground without composite materials. *(Tri- dung Ngo, 2020)*

UNSW Sydney, School of Materials Science and Engineering(2013), states that composite materials, also referred to as composites, are a combination of two or more materials that are mixed or joined on a macroscopic level. Composite materials are used in engineering applications where a pure material cannot provide the specific set of properties that are required. The composite can be tailor made to produce a set of properties that are unique and cannot be provided by the individual constituents alone.

Composites can be thought of as a single material that has been enhanced by the addition of another material. Typically, composites are a combination of a filler material, either particles or fibres, and a matrix material that surrounds the filler, usually a polymer.

Particles or fibres are added as a means of reinforcement and provide strength and stiffness to the composite.The matrix phase is added to bond the fibres together, protect the fibres from damage, and distribute the load from one fibre to another.

There are many common examples of composite materials used around us. Boats and surfboards are made from fibreglass, which is a combination of glass fibres in a polymer matrix. Concrete is a composite of cement and aggregate. Wood and bone are both natural composites.

If we consider fiberglass, for example, we can see the benefits that can be derived from combining materials.

We know that polymers have a low stiffness but are highly ductile. We also know that ceramics and glasses are very stiff and strong but are prone to catastrophic failure as a result of flaws made though processing.

By combining the two materials we can achieve a strong and stiff material without the risk of catastrophic failure. If a single fibre breaks then the load is simply transferred to other surrounding fibres through the polymer matrix.

The properties of the composite are determined by the properties of the fibres, their length, diameter, orientation, and amount, as well as the properties of the matrix, and the bonding between the matrix and the fibres.

The mechanical properties of a composite are primarily determined by the mechanical properties of the constituent materials.

The fibres act to resist tension, the matrix acts to resist shear, and both act together to resist compression

The use of composite materials for aircraft manufacturing has elicited of variety of reactions among members of the aviation industry. *(A&P Technician Powerplant Textbook – Jeppesen)*

- Aircraft manufacturers hails composite as a very durable highly manufacturable materials.
- Aircraft owners regard the new composite aircraft as light-weight and more effective than their metal counterparts
- Aircraft technicians all too often regard composite as either another name for traditional fiberglass, or as a mystery material only engineers will understand.

Composite materials are quickly becoming recognized as the most advance substance for fabrication of aircraft parts. Composite structures are made from a combination of fabrics, fiber, foams, and honeycombs materials bonded by a matrix or a resin system

WHAT IS A COMPOSITE STRUCTURE?

The term **composite** is used to describe two or more materials that are combined to form a structure that is much stronger than the individual components.

COMPOSITE ELEMENTS

The simplest composite is composed of two elements:

1. Matrix
2. Reinforcing Materials

Matrix is generally in a liquid form that serves as a bonding substance.

Reinforcing Materials is a solid form that provide the primary structural strength to the composite structure when combined in a matrix

In addition, adding core material saves overall weight and gives shape to the structure. The three main parts of a fiber-reinforced composite are the fiber, matrix, and interface or boundary between the individual elements of the composite.Any material can serve as a matrix material for composite. However, matrix materials are generally ceramics, metals, and polymers. In reality, the majority of matrix materials that exist on the composites market are polymer. There are several different polymer matrices which can be utilized in composite materials.

STRUCTURAL REPAIR MANUAL

ATA 100 contains the reference to the ATA numbering system which is a common referencing standard for commercial aircraft documentation. This commonality permits greater ease of learning and understanding for pilots, aircraft maintenance technicians, and engineers alike. The standard numbering system was published by the Air Transport Association on June 1, 1956. While the ATA 100 numbering system has been superseded, it continued to be widely used until it went out of date back in 2015, especially in documentation for general aviation aircraft, on aircraft Fault Messages (for Post Flight Troubleshooting and Repair) and the electronic and printed manuals.

This ATA number 52 to 57 is the reference numbers for structural member of the aircraft. This is important to composite technicians because they dealing about the structural parts of an aircraft.

Figure 1

Figures shows the ATA chapters important to Composite Technicians because they also dealing to Structural parts of an aircraft.

COMPOSITE ACCRONYMS; DEFINITIONS; AND RELATED TERMINOLOGIES

a. **AIRCRAFT MAINTENANCE MANUAL.** This manual developed by the aircraft Manufacturers that includes information prepared for the AMT or technicians who performs work on units, components and system while they are installed on the airplane.

b. **ACCELERATOR.** a chemical additives that quicken cure, or chemical reactions.

c. **ADDITIVES**. A material that are mixed into a two –part resin system to improve the properties of the systems.

d. **ADHESIVES**. A substance that is applied to two mating surfaces to bond them together by surface attachments.

e. **ADVANCED COMPOSITES.** Fibrous materials embedded in a resin matrix. The term ADVANCED applied those materials, which have superior strength and stiffness and the process in which they are manufactures.

f. **AREA WEIGHT.** The weight of the fiber reinforcement per unit area of tape of fabric.

g. **COMPONENT MAINTENANCE MANUAL (CMM).** A manual developed BY THE COMPONENT manufacturer and frequently adopted by the airframe manufacturer. A CMM is most frequently not approved by the FAA. Blanket approval comes through the AMM and SRM.

h. **COMPOSITE.** The term composite is define in FAA AC 4-214. A combination of two or more materials (reinforcing elements, fillers, and composite matrix binder), differing in form or composition on a macro-scale. The constituents retain their identities—that is, they do not dissolve or otherwise merge completely into one another, although they act in concert. Normally, the components can be physically identified and exhibit an interface between one another.

   And in Jeppesen the word composite simply defines as two or more substances which are combined to produce materials properties not present either substance is used alone.

i. **COMPRESSIVE STRENGTH.** The resistance to resist the crushing force.

j. **CONTAMINANT.** An impurity of foreign substance present in the marterials or environment that affects one or more properties of the materials, particularly adhesion.

k. **CORE CRUSH.** A compression damage of the core.

l. **CURE**. to change the physical properties of the mteril by chemical reaction, by the application of catalyst , heat and pressure , alone or in combination.

m. **FABRIC.** Individual fibers woven together to produce cloth.

n. **FIBER.** Single strands of materials used reinforcement because of its high strength and stiffness.

o. **ILLUSTRATED PARTS CATALOG**. A require document which is produced by the manufacturer. It has the parts and their part numbers exploded for identification.

p. **LAMINATE**. One Fabric resin layer that is bonded to adjacent layers in the curing process.

q. **Maintenance Organization (MO).** Persons performing a repair or alteration under parts 121 and 135, or repair stations certificated under part 145. As used in this AC, this term includes Maintenance Repair Organization(MRO), certificated repair stations (CRS), and operators' maintenance facilities.

r. **ORIENTATION**. The alignment of the fibers to the baseline set by the manufacturer for the perpendicular component.

s. **POT-LIFE** . The length of time that the resin, mixed with catalyst will be in a workable state.

t. **STRUCTURAL REPAIR MANUAL**. a manual which developed by the manufacturer to cover all items not listed as minor, maintenance , including instructions for structural repair, major component removal, installation and adjustment set up. Etch.

u. **SHELF LIFE**. The life span that a product will remain useful, and in FAA AC 43-214 define shelf life as the length of time a raw material may be in storage under

specific conditions and still meet the requirements of the applicable material specification, also known as storage life.

v. **Out Life.** The cumulative length of time a material may be out of freezer storage, prior to curing, and still maintain the required processability characteristics and mechanical properties. Also known as a limit on the amount of accumulated out time before further action needs to be taken to ensure the raw material is still usable (also known as work life).

FAA – Federal Aviation Administration
CAAP – Civil Aviation Authority of the Philippines
ACAP – Army's Advanced Composite Airframe Program
FRP – Fiber Reinforced Plastic
NDT – Nondestructive Testing
NDI – Nondestructive Inspections
PVC- Polyvinyl chloride
SRM - Structural Repair Manual
AMM- Aircraft Maintenance Manual
MSDS - Material Safety Data Sheet

Mastery Check

Self-Assessment: Before we proceed with our discussion, let's check how well you have understood the discussion so far. Using the table below, try to compare and contrast the following terminologies: **Time frame: 10-15 mins.** Please refer to the last page of the module for the rubrics.

Similarities	Terms	Differences
	Outlife vs Shelf Life	
	CMM vs AMM	
	Cure vs Additives	
	Fiber vs fabric	
	Composite vs Advance Composite	

Advantage and dis-advantages

Composite structures differ from metallic structures in several ways: excellent elastic properties, ability to be customized in strength and stiffness, damage tolerance characteristics, and sensitivity to environmental factors. Consequently, composites require a vastly different approach from metals with regard to their design, fabrication and assembly, quality control, and maintenance.

One main advantage to using a composite over a metal structure is its high strength-to-weight ratio. Weight reduction is a primary objective when designing structures using composite materials. In addition, the use of composites allows the formation of complex, aerodynamically contoured shapes, reducing drag and significantly extending the range of the aircraft. Composite strength depends upon the type of fibers and bonding materials used, and how the part is engineered to distribute and withstand specific stresses. (*(A&P Technician Powerplant Textbook – Jeppesen)*

ADVANTAGES OF USING A COMPOSITE

1. High strength to weight ratio
2. Flexible
3. Can resist high vibrations
4. Do not corrode
5. Reduced wear

APPLICATION OF COMPOSITE PLASTICS

1. Fairings
2. Flight control surfaces
3. Landing gear doors
4. L&T panels on the wing and stabilizers
5. Interior components
6. Floor beams & floor boards
7. H&V stabilizers primary structures on the large A/C
8. Primary wing and fuselage structures on new generation large aircraft
9. Turbine engine fan blades
10. Propellers

ASSIGNMENT no

Republic of the Philippines
PHILIPPINE STATE COLLEGE OF AERONAUTICS
Piccio Garden, Villamor Pasay City

Certificate Number: AJA16.0920

Institute of Engineering and Technology
Aircraft Maintenance Technology Department

AMT 2106 – AIRCRAFT MATERIAL CONSTRUCTION AND REPAIR II (COMPOSITE)

Name		**Instructor**	
Section		**Date:**	
Title		**Rating:**	

Assignment/ Research Type
Note :Individual activity/research
TITLE: COMPOSITE ADVANTAGES-DISADVANTAGES AND ITS APPLICATION TO AIRCRAFT STRUCTURES
Instruction: Follow the format given; font size 12; font style Arial. Etc.
Date of Submission:

- Based on the yesterday lecture presentation being sent to each student.

1. Composite until now is under improvement, discovery and development. Thus, each student was instructed to conduct Research on the additional advantages and dis-advantages thus composite has been sited, and also additional parts of aircraft structures converted to composite with corresponding picture or figure for each parts.
2. Please research the following :
   - Reinforcing materials and types
   - Matrix Materials and its kinds

Rubrics for Self- Assessment / Assignment

These basic rubric examples ensure that all parts of the assignment are present. They help students keep track of each element of a project. Checklists also let teachers see whether a student fully participated in an assignment, but they aren't as informative as other rubrics

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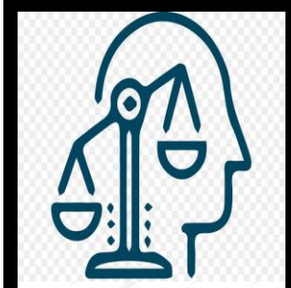
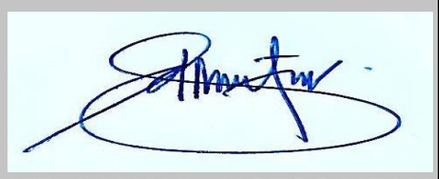
CRITERIA	INADEQUATE (Below Standard) 65%-74%	ADEQUATE (Meets Standard) 75%-84%	ABOVE AVERAGE (Exceeds Standard) 85%-92%	EXEMPLARY (Far Exceeds Standard) 93%-100%	SCORE
Organization	Writing lacks logical organization. It shows some coherence but ideas lack unity. Serious errors.	Writing is coherent and logically organized. Some points remain misplaced and stray from the topic. Transitions evident but not used throughout essay.	Writing is coherent and logically organized with transitions used between ideas and paragraphs to create coherence. Overall unity of ideas is present.	Writing shows high degree of attention to logic and reasoning of points. Unity clearly leads the reader to the conclusion and stirs thought regarding the topic.	
Level of Content	Shows some thinking and reasoning but most ideas are underdeveloped and unoriginal.	Content indicates thinking and reasoning applied with original thought on a few ideas.	Content indicates original thinking and develops ideas with sufficient and firm evidence.	Content indicates synthesis of ideas, in-depth analysis and evidences original thought and support for the topic.	
Development	Main points lack detailed development. Ideas are vague with little evidence of critical thinking.	Main points are present with limited detail and development. Some critical thinking is present.	Main points well developed with quality supporting details and quantity. Critical thinking is weaved into points.	Main points well developed with high quality and quantity support. Reveals high degree of critical thinking.	
Grammar & Mechanics	Spelling, punctuation, and grammatical errors create distraction, making reading difficult; fragments, comma splices, run-ons evident. Errors are frequent.	Most spelling, punctuation, and grammar are correct allowing reader to progress the essay. Some errors remain	Essay has few spelling, punctuation, and grammatical errors allowing reader to follow ideas clearly. Very few fragments or run-ons.	Essay is free of distracting spelling, punctuation, and grammatical errors; absent of fragments, comma splices, and run-ons.	
				GRADE (score/4)	



HONESTY CLAUSE

My signature below constitutes my pledge that all of my writing is my own work, with the exceptions of those portions which are properly documented



SHEILA MAY D. MOTOS,MEAM
Subject Instructor

_____	_____
Student Signature	**Parent Signature**