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Incorporating Advanced Aircraft Technologies into an Aeronautical Engineering Technology Curriculum

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Abstract

Researchers in the Aeronautical Engineering Technology program at Purdue University are exploring innovative ways to introduce and integrate aircraft maintenance data from their advanced training fleet of networked aircraft into an undergraduate Aviation curriculum. This report describes a work in progress toward that goal. This initiative will better prepare students for an industry where synthetic process visualization, drag and drop planning screens and "smart" personal computing device applications play a significant role in problem solving and daily aircraft operations. The goal is to equip students at all levels of the curriculum with awareness and modern methods of process visualization, troubleshooting and research using modern, networked air vehicles.

Keywords: NextGen, Engineering, Curriculum, Aircraft, Data, Learning

Introduction

Under a congressional mandate issued to the FAA, by 2025 all aircraft and airports in controlled U.S. airspace are expected to be connected to advanced, satellite-based networks that are linked to aircraft flight deck technologies that continually share real-time information among flight crews, ground crews and air traffic controllers. This transformation is known as the Next Generation Air Transportation System (NextGen) (FAA, 2008; 2010). On board flight parameters,

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system performance and maintenance status in real-time are now possible, even on small general aviation aircraft, as a result of this technology transformation effort. Few universities have the capital or laboratory upgrade capacity to keep pace with these changes. Overcoming the inertia of such a technology changeover can be a slow process. As a result, aerospace maintenance and engineering graduates within traditional learning environments are at risk of landing short of the technology fluency, assessment and collaborative problem solving competencies required to maintain modern "smart" aircraft within the digital aircraft environment.

Background

Modern general aviation aircraft fleets have real-time satellite data feeds, Wi-Fi, data storage cards and networked onboard computers as part of their standard equipment (Cirrus Aircraft, 2011; Garmin 1000, 2012). Students entering the workforce with knowledge and hands-on experience of working with network-enabled aircraft as pilots, engineering technicians or operations managers will emerge from technology-based programs wielding pertinent and adaptable skills much more suited to meet the unique challenges of working with "smart", next generation air vehicles.

In industry, students must also function as collaborative work group team members constructed around on-demand, linked air vehicle data systems. Educators have recognized changing learner needs for performing well in today's technology fields that are characterized by virtual collaboration, rapid data acquisition, computer assisted visualization and problem solving. The technology curriculum must transform to not just discuss this rapidly evolving work setting, but to immerse the learner and with direct application within the coursework material.

The networked aircraft described in this report offer an excellent platform for immersing technology students into a cross cutting, collaborative data-analysis environment using actual real-time data from a flying aircraft training fleet, very similar to what they will experience in the industry. Bringing today's computing capability into the classroom where students not only evaluate the data and graphics, but can construct, visualize, incorporate it into simulations and "touch" it in various visualized formats results in opportunities for deeper engagement among students (Johnson, Adams, & Haywood, 2011). Research shows increased achievement and understanding when classroom material is augmented with networked computing, which includes incorporating data acquisition and performance modeling similar to digital gaming simulations (Ash, 2009). Ash asserts that digital gaming and simulation style applications in the classroom can be a valuable additional tool for raising student achievement. The U.S. Department of Education (DOE) similarly reports that "21st-century competencies and such expertise as critical thinking, complex problem solving, collaboration, and multimedia communication should be woven into all content areas" in order for the future workforce to remain globally competitive (U.S. DOE, 2010, pg. xi). The DOE report supports the contention that modern professionals in technological fields, such as aviation, gather and analyze data using inquiry and visualization tools such as 3D modeling, data mining, problem solving and solution design. Using similar tools and approaches as a routine part of the original learning curriculum will enable learners to apply these same approaches to real-world problems early on, thus providing opportunities that prepare them to be more productive members of a globally competitive workforce (U.S. DOE, 2010, pg. xi).

Implanting data and technology application formats across courses also propels the instructor to continue learning (U.S. DOE, 2010, pg. 49). Far from negative, this fosters a collaborative learning environment while allowing the instructor to remain up to date on current computer and data display technologies. Leisisko, Lee, Wright, and O′Hern (2010) report a consistent pattern of increased student learning coupled with improved overall technology skills over time when technology can be applied consistently and taught by technology savvy instructor/coordinators. Education Week (2011) also cites a U.S. Department of Education study which found that upper level students in classes that blended both face-to-face and online elements performed better than those in solely online or face-to-face instruction.

Finally, Greaves, Hayes, Wilson, Gielniak, and Peterson (2010), in a study on the impact of technology-transformed schools, report that high-stakes testing outcomes (tests measuring key and in-depth content mastery) and overall learner achievement are greatly impacted when technological applications such as computer based tools are integrated and blended across classes within a curriculum. In addition, they cite a critical component of the project initiative reported here, in that digital resources enable a near real-time (just-in-time) data delivery capability, on demand from the learner or instructor, vastly improving data relevancy and timeliness and the benefit of collaborative learning by both instructor and learner.

Project Description

This report represents a work in progress to leverage Purdue University's advanced, network-enabled "NextGen" training fleet of Cirrus SR20 aircraft and their data capture and dissemination capabilities into real-time classroom and laboratory learning platforms.

This project was initiated with the discovery and learning vision of the Aviation Technology (AT) Department and that of Purdue University's College of Technology (COT) in mind. Both the AT and COT missions and visions emphasize excellence and leadership outcomes through learning, scholarship (discovery), and engagement activities. The goal was to enhance the learning experience of aviation technology students by utilizing real-time flight and maintenance data to expand the learning experience through deeper cognitive constructs and a more meaningful understanding of modern aircraft and the integrated systems they carry. This goal continues to be realized through the creation and gradual integration of new curricular components into existing learning modules within the aviation technology program. It incorporates hands-on learning, recognition, definition and application of data using Purdue's own "smart" aircraft training fleet of Cirrus aircraft as learning and research platforms. These aircraft incorporate advanced data capture and display technologies that could be leveraged to enhance the existing AT curricula. Emphasis was on inquiry-based, problem-based, and project-based/inductive teaching methodologies (Bertoline, 2011) through practical and classroom integration of the on-board computerized data-gathering and reporting capabilities of the Cirrus SR20 aircraft training fleet.

The project also supported AT′s ongoing reaffirmation of accreditation through ABET and ABBI by promoting quality and innovation through program improvement, as well as the implementation of new program initiatives related to program educational objectives (PEOs) (ABET, 2011). Data gleaned from the Cirrus fleet, for example, provides solutions for ongoing program improvements, enriches the pedagogical aspects of the AT curriculum and provides students and faculty with the opportunity to adapt to emerging technologies and changing disciplines.

Project Roadmap

This project consists of four key task strategies: 1) Cirrus aircraft technical review, along with the Aviation Technology Department's Data Center system reporting and display capabilities; 2) Research of Cirrus fleet engine sensor locations, flight panel display and Purdue's current Cirrus maintenance operations; 3) AET curriculum/plan of study assessment for Cirrus data insertion points, and; 4) Development of a draft implementation strategy matrix and sample Cirrus-based lab project in an existing AET course.

Cirrus Aircraft Technical Review

The Cirrus SR20 aircraft are powered by Continental IO-360-ES 200hp engines. They have a maximum operating altitude of 17,500 feet, and a maximum range of 785 nautical miles. Maximum takeoff weight is 3050 pounds and with a usable fuel capacity of 56 gallons and a useful load of 922 pounds. Each aircraft is 26 feet long, 8 feet 11 inches tall, and has a wingspan of 38 feet 4 inches (Cirrus Aircraft, 2011).

The Cirrus aircraft are also equipped with the state of the art Cirrus Perspective avionics package which includes the Garmin G1000®. The G1000® is an "all-glass avionics suite that makes flight information easier to scan and process" (Garmin 1000, 2012). The G1000® visually presents flight instrumentation, navigation, weather, terrain, air-traffic, and engine data. All Purdue Cirrus SR20s are fitted with dual 12 inch screens, dual communication, navigation, Wide Area Augmentation System (WAAS) GPS capabilities, XM weather, and audio onboard (Figure 1).

Three of Purdue's SR20 aircraft are equipped with synthetic vision technology for additional 3D representation of ground, air traffic and other obstacles displayed when user visibility is impeded by cloud or other environmental conditions. There is also a Garmin GFC™ 700, which is an advanced attitude and heading reference system (AHRS). This automatic flight control system provides flight director, autopilot, yaw damper, automatic and manual electric trim capabilities (Garmin 700, 2012).

The G1000® is capable of capturing 120 separate data sets (parameters) every second, providing an abundance of useful performance data capable of being integrated and assimilated into many of the AET courses in the new plan of study (Appendix B).

Currently, data from the Cirrus aircraft are provided to the Aviation Technology Department's data center by removing memory scan cards from the G1000® units and manually uploading to the data servers. However, development is ongoing to integrate aircraft onboard Wi-Fi reporting capabilities. Wi-Fi has already been installed and is operating on the ramp areas experimentally, and the Cirrus aircraft will be updated with new antennas to allow for controlled wireless downloading of data. Wireless "middleware" data units will be used to control the wireless download process.

Evaluation of AT Data Center System

Anticipating the need for and value of the data available for research and learning from an advanced technology aircraft fleet, and in order to close the gap between educators and technology, the AT Department has developed a centralized aircraft data center. This center has the capability to display integrated aircraft operating

Figure 1. SR20 Primary Flight Display "glass" flight deck display screen.

performance parameters (Appendix A – Sample Cirrus data screen) as well as aircraft post-flight positions, tracking and dynamic performance displays.

With this type of data-display capability in mind, available data was further evaluated for relevance and ease of accessibility specific first to the Aeronautical Engineering Technology (AET) portion of the curriculum where students study and apply aircraft maintenance, and to the lifecycle management principles in lecture and laboratory environments. Primary data categories considered for integration into the coursework were related to the aircraft's powerplant and include cylinder head temperature, exhaust gas temperature, RPM, dual alternator voltages, and fuel flow. Since pitch/roll angles and lateral acceleration parameter data are also available, new curricula could be developed around imposed stress loading on the structure of the aircraft in flight. Research could then be conducted to determine structural integrity through advanced inspection procedures utilizing engineering load calculations on a real-world, in-service aircraft.

Research of Cirrus Engine Sensors, Flight Panel Display and Hangar 6 operations

To increase the team's own knowledge of the technology available to integrate into the classroom, the team visited Purdue's Aviation Maintenance Department at Hangar 6 and observed live maintenance operations being conducted on the Cirrus fleet and received a hands-on overview of the Garmin 1000′s® reporting/display capabilities. From a maintainer's perspective, the engine sensor system coupled with flight deck displays was discovered to provide the technician with new levels of operational data to assist in troubleshooting, trend monitoring and aircraft inspection procedures.

Technical documentation used included the Cirrus Quick Reference Guide, which was one of several technical system overview resources. This guide, in particular, was quickly identified as a significant assistive tool for AET faculty and students, providing a general systems overview of the Cirrus aircraft. It offered an excellent foundation to assist in the development of new curricula and additional AET laboratory exercises. Therefore, this guide was incorporated as recommended supporting technical material that could be incorporated into classroom and laboratory instruction.

AET Curriculum/Plan of Study Assessment for Cirrus Data Insertion Points

The AET program is designed under the auspices of the FAA and is a certified FAR 147 Aviation Maintenance School. Students have the opportunity, upon graduation, to take the written, oral and practical examinations to become a certificated FAA Airframe and Powerplant Mechanic. The AET program is also accredited by ABET and adheres to that organization's policy requiring that accredited institutions provide stimulating and innovative curricula in the applied sciences.

Development of implementation strategy matrix and laboratory projects

The current AET plan of study for the 2011–12 academic year (Appendix B), along with existing syllabi for each course, were reviewed and topic sections within each AET course evaluated for relevant insertion points of related Cirrus aircraft data. A matrix showing possible Cirrus data topics relevant to AET courses was created (Appendix C). The courses are listed to systematically coincide with the student's progress through the program. Faculty could then determine the extent and specific application of new data to be introduced into their particular coursework.

A progressive guide utilizing foundational pedagogical taxonomies related to learning objectives (Figure 2) was created based on Bloom's Taxonomy (Bloom, 1956; Krathwohl, 2002) to assist in classroom and applied laboratory project placement on the matrix.

Application and Discussion

In the Fall semester of 2011, an introductory module on the Cirrus aircraft's advanced flight deck and maintenance data capture and reporting capabilities was introduced into a lecture-only aviation course within the AET plan of study, AT 258 – Air Transportation. As a larger introductory course offered for all three AT discipline plans of study covering air transportation, this class consisted of mostly freshmen and sophomore aviation students from all three AT disciplines: Aeronautical Engineering Technology, Professional Flight Technology and Aviation Management. Using the learning outcomes identified for 100- and 200-level applications in Figure 2 and the sample course integration matrix topical suggestions (Appendix C), an introduction to the Cirrus aircraft and AT Department's emerging data center capabilities was presented as part of a larger discussion on the U.S. Next Generation Air Transportation System and related aircraft technologies. The authors were able to secure an available Cirrus aircraft to be brought to the ramp space near the classroom (located on the Purdue Airport), and a subsequent tour, demonstration, and paper-based component identification exercise was given. Feedback from the students was very positive. They cited the relevance of learning about something they could see, put their hands on and also the potential to engage in active research as an undergraduate student.

In the Spring semester of 2012, the same data introduction and aircraft exploration module was introduced into a 100-level version of this introductory course, called AT 102 – Aviation Business, with the same level of student interaction and active interest observed. When several of the students expressed further interest in self-directed learning and sharing with the other students, relating their own experiences as beginning flight students, this active learning engagement opportunity was further leveraged. A volunteer group of students, who were actually flying the Cirrus aircraft as part of their curriculum, were tasked to develop a short introductory module on the flight deck layout and data displays of the Cirrus aircraft they flew and coordinated a hands-on, post-module walk around tour of the aircraft. They were challenged to develop this module covering the Cirrus airplane and its systems at a more in-depth user level and deliver it to the rest of their peers in class. As with the previous course introduction, student response was again positive and students were much more actively engaged in post-delivery question-and-answer time with their peer group. In addition, questions focused largely on availability and participation in future related research projects.

Perhaps the most exciting result (for the author who teaches this course) was the additional unsolicited student volunteers from all three disciplines for research assignments, papers and presentations, all related to "NextGen" and the modernization of air transportation and aircraft data systems. Although these results and feedback are clearly anecdotal, the level of student excitement and participation ignited at the point of topic application was enough to bolster still deeper project-design ideas for future classes, which include data profiling and developing predictive maintenance interval inspections schemes, to name just a few.

During Fall 2011 and early Spring 2012, beta versions of upper-level 300- and 400-level course lab projects were also created by other faculty members as part of planned hands-on laboratory research projects for AT 307 – Advanced Aircraft Systems (Appendix D – Sample Cirrus Aircraft Laboratory Exercise) and AT 476 – Gas Turbines (Appendix E – Sample Embraer Phenom 100 Aircraft Laboratory Exercise).

AET Course Level	Learning Objectives
100 Level	Knowledge/Remembering Define, list-recall-remember
200 Level	Comprehension/Understanding Describe-discuss-explain-identify
300 Level	Application/Applying Employ-demonstrate-explain-illustrate
400 Level	Analysis/Analyzing Compare-contrast-differentiate-experiment
Capstone and applied projects Level	Synthesis/Creating Assemble-construct-design-develop
Graduate Level	Evaluation Appraise-defend-judge-assess

Figure 2. Learning objectives for integration of aircraft data system parameters.

These exercises incorporate evaluation of mechanical, electrical and electronic aircraft engine tachometer systems of both older and modern Cirrus piston aircraft as well as Purdue's newest Embraer Phenom Very Light Jet (VLJ), which has similar real-time data capture and dissemination capabilities to that of the Cirrus fleet. These exercises were developed to include data mining from a central maintenance computer and online e-manuals, and are targeted to be implemented in AET laboratory exercises for courses in the Fall of 2012.

Conclusions

The advanced data-reporting capabilities of Purdue's Cirrus aircraft training fleet, the emerging capabilities of the Aviation Technology Department's data center and hands-on curriculum application provide a versatile and relevant gateway for next generation aircraft awareness and applied, immersive learning for both students and faculty. Based on preliminary evidence observed in the classroom and laboratory environments, it is believed that innovative curriculum enhancements and deeper learner experiences can be realized through the integration of the existing asset of the advanced training fleet, as demonstrated here.

The integration strategy of the aircraft data available as demonstrated here is believed to enable significant future potential for faculty collaboration, increased interagency engagement across all disciplines of aviation technology and continuous improvement throughout the educational process.

Appendix A

Sample Cirrus Data Screen

deg F	deg F	deg F	deg F	deg F	deg F	deg F	deg F	deg F	deg F	deg F	deg F
E1 CHT1	E1 CHT2	E1 CHT3	E1 CHT4	E1 CHT5	E1 CHT6	E1 EGT1	E1 EGT2	E1 EGT3	E1 EGT4	E1 EGT5	E1 EGT6
184.61	184.07	184.38	181.32	180.44	176.32	133.67	135.53	132.56	125.64	133.57	125.64
184.63	184.05	184.37	181.32	180.43	176.34	133.65	135.52	132.63	125.69	133.63	125.65
184.58	184.04	184.35	181.29	180.45	176.32	133.64	135.53	132.57	125.65	133.57	125.68
184.59	184.04	184.34	181.29	180.43	176.31	133.65	135.51	132.56	125.68	133.6	125.68
184.6	184.01	184.34	181.28	180.4	176.28	133.64	135.51	132.62	125.71	133.61	125.64
184.57	184.01	184.31	181.25	180.4	176.28	133.61	135.51	132.56	125.71	133.6	125.65
184.54	183.98	184.28	181.23	180.37	176.26	133.6	135.5	132.53	125.71	133.56	125.71
184.52	183.97	184.28	181.23	180.37	176.25	133.6	135.51	132.56	125.71	133.57	125.66
184.51	183.95	184.25	181.23	180.34	176.22	133.61	135.5	132.61	125.71	133.58	125.68
184.49	183.93	184.24	181.2	180.34	176.22	133.59	135.5	132.58	125.69	133.55	125.69
184.49	183.93	184.22	181.2	180.32	176.2	133.57	135.5	132.51	125.73	133.55	125.72
184.46	183.89	184.22	181.17	180.31	176.2	133.58	135.47	132.56	125.75	133.56	125.75
184.43	183.87	184.19	181.17	180.28	176.17	133.54	135.5	132.56	125.72	133.56	125.72
184.45	183.87	184.17	181.14	180.28	176.17	133.54	135.5	132.52	125.75	133.53	125.74
184.41	183.86	184.16	181.11	180.26	176.15	133.77	135.48	132.15	125.69	133.35	126.03
184.4	183.86	184.13	181.09	180.25	176.14	133.51	136	132.88	126.14	133.97	126.36
184.37	183.83	184.13	181.08	180.23	176.14	134.15	136.57	133.57	127.21	134.62	126.87
184.37	183.81	184.11	181.1	180.22	176.11	134.76	146.76	134.56	128.11	135.27	127.39
184.35	183.8	184.08	181.05	180.19	176.1	142.4	163.23	147.14	139.3	146.16	152.34
184.38	183.8	184.07	181.04	180.21	176.13	142.46	162.47	147.2	139.94	146.29	152.16
184.43	183.81	184.1	181.06	180.24	176.14	143.71	162.24	149.59	139.29	148.19	149.94
184.45	183.81	184.1	181.07	180.28	176.17	142.18	160.92	145.71	139.7	145.33	151
184.46	183.83	184.13	181.08	180.33	176.2	142.51	160.47	146.43	139.55	145.72	150.31
184.49	183.86	184.15	181.08	180.37	176.22	142.38	159.92	146.21	139.51	145.64	149.83
184.53	183.86	184.16	181.08	180.4	176.24	142.34	159.58	146.01	139.3	145.3	149.44
184.52	183.85	184.18	181.08	180.43	176.23	142.21	159.08	145.74	139.12	144.97	149.12
184.54	183.86	184.17	181.08	180.46	176.25	142.04	158.67	145.5	138.87	144.76	148.72
184.54	183.84	184.19	181.07	180.44	176.25	141.88	158.15	145.3	138.61	144.51	148.29
184.57	183.86	184.19	181.08	180.45	176.25	141.73	157.69	145.03	138.35	144.29	147.91
184.57	183.84	184.21	181.08	180.45	176.26	141.51	157.2	144.71	138.11	143.99	147.5
184.57	183.86	184.21	181.05	180.46	176.26	141.36	156.75	144.49	137.87	143.78	147.05
184.55	183.83	184.19	181.05	180.46	176.25	141.31	156.38	144.36	137.72	143.68	146.76
184.54	183.83	184.19	181.02	180.46	176.25	141.01	155.79	143.97	137.37	143.34	146.29
184.57	183.83	184.19	180.99	180.43	176.23	140.82	155.34	143.61	137.11	143.01	145.88
184.54	183.83	184.19	180.99	180.45	176.22	140.66	154.87	143.42	136.88	142.82	145.45
184.52	183.8	184.15	180.99	180.43	176.22	140.53	154.44	143.17	136.64	142.64	145.09
184.51	183.8	184.16	180.96	180.4	176.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Appendix B

Purdue Aeronautical Engineering Technology Plan of Study

AVIATION TECHNOLOGY, AERONAUTICAL ENGINEERING TECHNOLOGY

ENTERING DATE AUGUST, 2011 NAME: ____________________

FIRST SEMESTER	SUBSTITUTE	GR	CR	SECOND SEMESTER	SUBSTITUTE	GR	CR
AT 101 - Gateway to Aviation Technology			3	AT 103 - Aerospace Vehicle Propulsion & Tracking			3
ENGL Selective – English Composition			3	AT 278** - Nondestructive Testing			3
MA 159 – Precalculus			5	PSY 120 – Elementary Psychology			3
TECH 120 - Technology and the Individual			3	MET 162 - Computational Analysis Tools In MET			1
POL Selective[1]			3	COM 114 - Fundamentals of Speech Communication			3
				Calculus Selective[1]			3
Total			17	Total			16

THIRD SEMESTER	SUBSTITUTE	GR	CR	FOURTH SEMESTER	SUBSTITUTE	GR	CR
AT 201 - Aircraft Design & Structures			3	AT 102 - Aviation Business			3
AT 202 - Aerospace Vehicle Systems Design, Analysis & Operations			3	Minor Selective (AT 208 for the A&P)*			3
Minor Selective (CGT 163 for A&P)			2	Minor Selective (AT265 for the A&P)**			3
AT 267* - Fixed And Rotary Wing Assemblies			3	PHYS 218 – General Physics			4
MET 111 - Applied Statics			3	ECON Selective[1]			3
Total			14	Total			16

FIFTH SEMESTER	SUBSTITUTE	GR	CR	SIXTH SEMESTER	SUBSTITUTE	GR	CR
AT 203 - Aviation Operations Management			3	AT 308** - Aircraft Materials Processes			3
AT 272* - Introduction To Composite Technology			3	AT 335** - Avionics Systems			4
AT 376 - Aircraft Gas Turbine Engine Technology I			3	AT 370** - Advanced Aircraft Systems			3
AT 363* - Fundamentals Of Powerplant Systems			3	TECH 330 - Technology and the Global Society			3
STAT 301 - Elementary Statistical Methods			3	Adv. ENGL Sel[1]			3
Total			15	Total			16

SEVENTH SEMESTER	SUBSTITUTE	GR	CR	EIGHTH SEMESTER	SUBSTITUTE	GR	CR
AT 307* - Advanced Aircraft Systems			3	AT 372 - Aircraft Maintenance Practices			3
AT 476 - Aircraft Gas Turbine Engine Technology II			3	AT 497** - Applied Research Project			3
AT 496* - Applied Research Proposal			1	Elective			3
(AT477 for the A&P)			0	Minor Selective (AT 402 for the A&P)			4
AT 445 - Aircraft Electronics			4	TECH COM[1]			3
TECH 320 - Technology and the Organization			3	Globalization[2]			0
Total			14	Total			16

Appendix C

Sample AET Course Integration Matrix

AET Course	Instructor	Cirrus/Garmin Data Topic Recommendation	FAA – Part 147 Required
AT 101- Gateway to Aviation Technology (Sem. 1)		Overview general system – Provide Cirrus Ops./system overview manual	No
AT 103 – Aerospace Vehicle Propulsion & Tracking (Sem. 2)		RPM, OilT, OilP	Yes
AT 201 – Aircraft Design & Structures (Sem. 3)		LatG, LongG (g-loads). Provide Strengths and Statics manual-	No
AT 202 – Aerospace Vehicle Systems Design, Analysis & Operation (Sem. 3)		EGT, CHT, Ops. Analysis – Provide Cirrus Ops./system overview manual	Yes
AT 203 – Aviation Operations Management (Sem. 5)		Fuel consumption vs. engine performance	No
AT 102 – Aviation Business (Sem. 4)		General Cirrus Ops./system overview manual	No
AT 307 – Advanced Aircraft Systems (Sem. 7)		Provide Cirrus Ops./system overview manual. Total Cirrus data integration.	Yes
AT 267 – Fixed and Rotary Wing Assemblies (Sem. 3)		LatG, LongG (g-loads). Provide Cirrus Ops./system overview manual	Yes
AT 272 – Introduction to Composite Technology (Sem. 5)		LatG, LongG (g-loads) Provide Cirrus Ops./system overview manual – see specific to composite repair section	Yes
AT 278 – Nondestructive Testing (Sem. 2)		LatG, LongG (g-loads) for NDT eval.	Yes
AT 308 – Aircraft Materials Processes (Sem. 6)		LatG, LongG (g-loads) for stress/strain eval	No
AT 335 – Avionics Systems (Sem. 6)		AltGPS, HSIS, NAV1, NAV2 HCDI, VCDI; Entire G1000 system. Provide Cirrus Ops./system overview manual	Yes
AT 372 – Aircraft Maintenance Practices (Sem. 8)		Provide Cirrus Ops./system overview manual. Total Cirrus data integration.	Yes
AT 445- Aircraft Electronics (Sem. 6)		AltGPS, HSIS, NAV1, NAV2 HCDI, VCDI; Entire G1000 system. Provide Cirrus Ops./system overview manual	Yes
AT 262/370 – Advanced Aircraft Systems (Sem. 6)		EGT, CHT, MAP, Provide Cirrus Ops./system overview manual	Yes
AT 271/363 – Fundamentals of Powerplant Systems (Sem. 5)		Applicable power management: Throttle/prop control integration. Provide Cirrus Ops./system overview manual	Yes
AT 376 – Aircraft Gas Turbine Engine Tech. I (Sem. 5)		Provide Cirrus Ops./system overview manual (Later Review)	Yes

Appendix D

Sample Cirrus Aircraft Laboratory Exercise

AT 307 Laboratory Project One Name ________________

Mechanical Electrical/Electronic Engine Tachometer System

Project Format:

- Research of print and online materials
- Inspection and interpretation of on-aircraft components
- Removal and installation of on-aircraft components
- Airworthiness determination of installed equipment

Given: Cessna 310 Service Manual, Piper PA 40 Service Manual, Cirrus SR20-22 System overview manual

1. The student will research the print materials concerning the operation of the tachometer system for each of three aircraft given. The student will write a short narrative describing each tachometer system using the service manual as a reference only.

Narrative ________________________

Instructor signature __________________

2. The student will observe the location of the tachometer system on-aircraft. The student will remove those panels and cowlings necessary to observe and inspect the tachometer system components. The student will identify for the observing instructor the components of the tachometer system for each aircraft.

Observation _________________________

Instructor signature _______________________

3. The student will remove, detach, inspect and reinstall the operating components of the tachometer systems including mechanical drive cable, tachometer generator, cannon plugs connection and tachometer indicator.

Removal/replace _____________________

Instructor signature _________________________

4. The student will inspect the tachometer indicator and system determining proper installation, connection and correct dial indication and range markings as per engine and aircraft type certificate data sheets.

TCDS ____________________________

Instructor signature ________________________

References:
Cessna 310R Service Manual, Chapters 7, 10.
Piper PA 30–39 Service Manual, Chapters 8, 10.
Cirrus SR20–22 Service Manual, Chapters ATA 31, 77.
Cessna 310R TCDS # 3A10
Piper PA 30,39,40 TCDS# A1EA
Cirrus SR20–22 TCDS# A00009CH

Appendix E

Sample Embraer Phenom 100 Aircraft Laboratory Exercise

AT 476 Laboratory Project One Name ________________

Project Format:

Introduction to electronic and online aircraft maintenance documents

Research of print and online materials

Inspection and interpretation of on-aircraft components

Removal and installation of on-aircraft components

Airworthiness determination of installed equipment

Given: Embraer Phenom 100 Electronic Maintenance Manual, Central Maintenance Computer, Fault Isolation Manual, and Aircraft Health and Diagnostics Manual

1. The student will research the materials concerning the operation of the Embraer Phenom 100 Aircraft Health Analysis and Diagnostic System. The student will write a short narrative describing the AHEAD system.

Narrative ________________________

Instructor signature ______________________

2. The student will observe the location of the Central Maintenance Computer system on-aircraft. The student will review the information from the CMC to establish the health of the engine systems. The student will identify for the observing instructor the components of the CMC system in the aircraft.

Observation __________________________

Instructor signature _________________________

3. The student will be given simulated faults from the CMC system. The student will review the faults and consult the Fault Isolation Manual for corrective measures. The student will determine and document the corrective measures that must be taken to return the aircraft to an available for dispatch condition.

Fault Repair Action ___________________

Instructor signature _________________________

4. The student will operate the AHEAD system to determine if the maintenance performed has corrected the original fault that was displayed on the CMC. The student interrogates the CMC system to verify the faults have cleared.

Document Aircraft Forms __________________

Instructor signature _____________________________

References:
Embraer Phenom 100 Electronic Maintenance Manual
Embraer Phenom 100 Aircraft Central Maintenance Computer
Embraer Phenom 100 Fault Isolation Manual
Aircraft Health Analysis and Diagnostics Manual (AHEAD 2.0)

References

Aviation Accreditation Board International. (2011). Mission and Rationale. Retrieved Jul. 27, 2011 from http://www.aabi.aero/rationale.html

Accredation Board for Engineering and Technology. (2011). Mission, Vision and Strategic Plan. Retrieved Aug. 10, 2011 from http://www.abet.org/mission.shtml

Ash, K (2009). Game on: High-tech simulation linked to learning. *Education Week*, 2(4), 13. Retrieved Jul. 12, 2012 from http://www.edweek.org/dd/articles/2009/06/17/04gadgets.h02.html

Bertoline, G. (2011). Future college of technology. A vision based detailed analysis and implementation plan. Future College of Technology Plan.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive Domain. New York: Longmans, Green.

Cirrus Aircraft. (2011). SR20 The Perfect Dual-role Airplane. Retrieved Feb. 29, 2011 from http://cirrusaircraft.com/sr20/

Education Week. (2011). Technology in Education. Retrieved June 12, 2012 from http://www.edweek.org/ew/issues/technology-in-education/

Federal Aviation Administration-JPDO (2008). Federal Aviation Administration – Joint Planning and Development Office (FAA-JPDO). "Safety Culture Improvement Guide" V.1.0. Paper number 08-010. p. 22.

Federal Aviation Administration, (2010). FAA NextGen Implementation Plan.

Garmin 1000 (2012). Garmin 1000 Product Overview. Retrieved April 9, 2012 from https://buy.garmin.com/shop/shop.do?pID=6420&ra=true

GFC 700 (2012). GFC 700 Product Overview. Retrieved April 9, 2012 from https://buy.garmin.com/shop/shop.do?pID=70143

Greaves, T.; Hayes, J.; Wilson, L.; Gielniak, M.; & Peterson, R. (2010). The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness, MDR 2010. Project RED (Revolutionizing Education) Report. Retrieved April 4, 2012 from http://www.pearsonfoundation.org/downloads/ProjectRED_TheTechnolgyFactor.pdf

Johnson, L., Adams, S., & Haywood, K., (2011). The NMC Horizon Report: 2011 K-12 Edition. Pg. 15–16. Austin, Texas: The New Media Consortium.

Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview, Theory Into Practice. 41:4. p. 212–218.

Lesisko, L., Lee, J., Wright, R.J., & O′Hern, B. (2010). Technology integration: A best practice perspective. Paper presented at the *Annual Meeting of the Eastern Educational Research Association* (Savannah, GA, Feb 10–13, 2010).

Purdue University (2011). College of Technology online Plan of Study for Aeronautical Engineering Technology Fall 2011. Retrieved July 31, 2011 from http://www.tech.purdue.edu/AT/Academics/Undergraduate/POS/index.cfm

U.S. Department of Education, Office of Educational Technology. (2010). Transforming American education: Learning powered by technology. National educational technology plan 2010. Washington, DC: Author. Retrieved July 12, 2011 from http://www.ed.gov/sites/default/files/netp2010.pdf